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STABILIZATION OF THE PETROLEUM INDUSTRY

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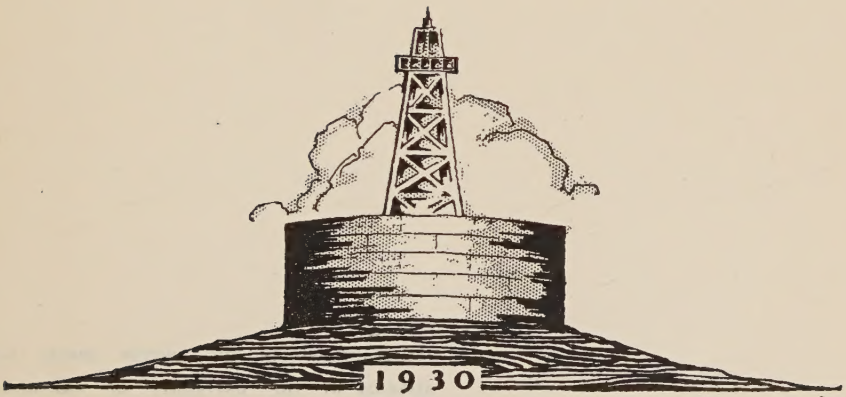
STABILIZATION OF THE PETROLEUM INDUSTRY

LEONARD M. LOGAN, JR.



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STABILIZATION OF THE PETROLEUM INDUSTRY

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TO
MY FATHER AND MOTHER

PREFACE

THE petroleum industry, like most industries, is confronted with a serious problem. This problem, however, is unusual; it is peculiar to this industry alone because petroleum is an exhaustible resource. Its origin and source are unknown, although there are plausible theories explaining them. Our institution of property rights has brought about a situation creating a condition of overproduction. Solutions to the problem have been suggested from time to time. Some have been tried, some have not.

The purpose of this book is to give the background out of which the problem has grown, to explain the problem, and to discuss the principal plans offered for its solution.

I am indebted to many for the valuable aid given to me in the preparation of this book. I am especially indebted to Dr. Charles N. Gould, director of the Oklahoma geological survey, for material assistance in making its publication possible; to Professors H. C. George and Victor H. Kulp for their valuable criticisms; to Joseph A. Brandt for his helpful literary advice; to Mr. L. C. Snider, the United States bureau of mines, the American Petroleum Institute, the American Institute of Mining and Metallurgical Engineers, the Mid-Continent Oil and Gas Association, *The Oil and Gas Journal,* and the *National Petroleum News* for data otherwise unobtainable; to my colleagues, Dean A. B. Adams, Professors A. E. Chandler and Edwin C. Petty, for their able suggestions; and to my former professors, John R. Commons, W. H. Kiekhofer, W. A. Scott, Selig Perlman, and Martin G. Glaeser for an inspiration without which this work would have been impossible.

Norman, Oklahoma, July, 1930. LEONARD M. LOGAN, JR.

CONTENTS

PREFACE vii

CHAPTER ONE

INTRODUCTION 1

CHAPTER TWO

THE PETROLEUM INDUSTRY 9

CHAPTER THREE

NATURE AND ORIGIN OF CRUDE OIL 33

CHAPTER FOUR

OIL AND GAS RIGHTS 41

CHAPTER FIVE

THE PRODUCTION OF PETROLEUM 71

CHAPTER SIX

PETROLEUM—DEMAND, SUPPLY AND PRICE 93

CHAPTER SEVEN

STABILIZATION EFFORTS OF THE INDUSTRY 125

CHAPTER EIGHT

PRORATION 157

CHAPTER NINE

UNIT OPERATION 171

CHAPTER TEN

THE OIL INDUSTRY AND GOVERNMENT 191

CHAPTER ELEVEN

THE PROBLEM 209

APPENDIX 221

BIBLIOGRAPHY 235

INDEX 243

STABILIZATION OF THE PETROLEUM INDUSTRY

CHAPTER ONE

INTRODUCTION

STABILIZATION of the petroleum industry is a two-fold problem, involving both engineering and economics. It is the economic aspect of stabilization that is to engage our attention in this book; in this particular problem, waste and conservation are the two most important elements. They involve a theory of value, as do most of the other pressing modern economic problems.

Waste, as well as conservation, has been interpreted in various ways by writers in the industry. Factors of waste in the petroleum industry include the mis-application of labor and capital, as well as a resource that cannot be replaced. But when is there such mis-application? There is no unanimity of opinion in answer to this question. At the annual meeting in 1927 of the American Petroleum Institute, President E. W. Clark remarked:

> What is waste in the oil business? What is conservation? I have made a study of these two terms as applied to the manner in which the petroleum industry is conducting its exploration and production operations. Some of our critics possibly have some inkling as to what one or both of these two words really mean, but generally speaking, most of them do not know any more than I about a proper interpretation of the two terms; and my conclusion supplemented by studies made by competent attorneys, capable engineers, and other technical men, leads me to believe that a proper and complete definition of either one is an impossibility. What is apparently conservation in some cases is in fact profligate waste in others and vice versa.[1]

The Oklahoma law interprets waste broadly. In fact, waste is defined in such broad terms that they have rendered the law practically useless. It is meaningless because the definition is in terms of itself. In other words the law says that waste is waste. It reads as follows:

> That the term waste as used herein, in addition to its ordinary meaning, shall include economic waste, underground waste, surface, and waste incident to the production of crude oil or petroleum in excess of transportation or marketing facilities or reasonable market demands. The corporation commission shall have authority to make rules and regulations for the prevention of such wastes, and for the protection of all fresh water strata, and oil and gas bearing strata, encountered in any well drilled for oil.[2]

This law became effective February 11, 1915, after the opening of the Cushing pool. By May, 1915, production reached its peak in this pool with an average daily production of 305,000 barrels. From 1911 to 1915 the oil market was demoralized by a superabundance of oil. At no time during this period did the average price of crude oil in the United States go above

1. E. W. Clark, "What the Industry Has Done," *The Lamp,* published by the Standard Oil Company of New Jersey, New York. Vol. X, No. 4, 1927, p. 17.
2. *Compiled Oklahoma Statutes,* 1921, Vol. II, Sec. 7956.

ninety-six cents. It was to correct this condition that the Oklahoma law was passed. One producer was brought into the district court at Tulsa for violation of the commission's order. The defendant won the case. For a decade following the enactment of this law the corporation commission of Oklahoma has been powerless almost in its ability to restrict the production of oil, due largely to the lack of an adequate definition of waste.

The Texas law is slightly more specific in what constitutes waste.

> The term waste in addition to its ordinary meaning shall include (a) escape of natural gas in commercial quantities into the open air from a stratum recognized as a natural gas stratum; but this is not intended to have application to gas pockets in high points in strata recognized as oil strata; (b) drowning with water a gas stratum capable of producing gas in commercial quantities; (c) underground waste; (d) the permitting of any natural gas well to wastefully burn; (e) the wasteful utilization of such gas; (f) burning flambeau lights, except when casing-head gas is used in same; provided, not more than four may be used in or near the derrick of a drilling well, and (g) the burning of gas for illuminating purposes between 8 o'clock a. m. and 5 o'clock p. m., unless the use is regulated by meter.[3]

It is difficult to tell what is the ordinary meaning of waste. Webster's *New International Dictionary* lists about seventy-five interpretations. About half of them overlap in meaning. The Oklahoma law refers to waste above and below the surface of the earth while the Texas law, in its specific details, deals more with underground waste and waste of natural gas. These laws have been useful in curtailing the physical losses of petroleum and natural gas but they have been ineffective, as the history of production in these two states will show, in remedying the situation.

President Coolidge, in his letter constituting the federal oil conservation board, December 19, 1924, said: "That overproduction in itself encourages cheapness, which in turn leads to wastefulness and disregard to essential values."[4] Pertinent to this very problem, President Coolidge raises a question in what is meant by essential values. Before there can be a satisfactory solution there must be a common understanding as to what is essential value. There has always been more or less confusion concerning the meaning of value. This confusion has crept into the consideration of this problem. In 1912, 1913, and 1914 the United States bureau of mines and the United States geological survey called the attention of the public to waste in the petroleum industry through various technical bulletins. Their purpose was to show that there was considerable loss of oil in the methods of recovery. The attitude taken by the bureau of mines and geological survey was that petroleum is a resource that cannot be replaced and any loss results in a loss of utility to society.

3. Railroad commission of Texas, *Oil and Gas Conservation Law and Rules and Regulations for the Conservation of Crude Oil and Natural Gas.* Oil and Gas Circular No. 13, p. 1.

4. Report of the Federal Oil Conservation Board to the President of the United States, September, 1926. Part I, p. 1.

Many private agencies took up the refrain. Appearing from time to time in the daily newspapers and in magazines various writers have criticised the industry for its wastefulness, accusing it of dissipating a valuable resource, thus bringing about the loss of a useful good to society. From their viewpoint waste is a loss in utility.

Two examples will suffice to illustrate the tenor of their criticisms.

Oil is used to produce light, to generate power, and to save power by reducing friction in the running of machinery. Which of these three uses of oil should be placed first? ..... Oil is cheap to get and convenient to use. There is, therefore, a distinct temptation to use it unheedingly. A doctrine of oil-conservation, with a view to its more rational utilization, is as important as that of forest-conservation with a view to reforestation. . . . . The greatest waste in the utilization of oil today lies in the burning up of enormous quantities of the more valuable compounds, through irrational refining and through too great a use of oil under boilers for fuel purposes. The trend is to concentrate on lubricants and on gasoline, though the time is coming when greater emphasis will be laid on the first than on the second. So long as operation of modern machinery is impossible without lubricants, and so long as oil is the sole source of high-speed lubricants, it is a crime against civilization to permit a single recoverable gallon of lubricant to be sacrificed for the sake of more or less easily replaceable fuel.[5]

The next illustration is more pungent than the preceding one.

To sum up in words of competent critics, "less than twenty-five per cent of the petroleum underground reaches the pipeline. If we subtract from this proportion the losses involved in improper and wasteful methods of utilization, the recovery factor becomes perhaps as low as ten per cent. . ." Such is the verdict of the Smithsonian Institution. Small wonder, therefore, that Sidney Brooks, an eminent English journalist, said in the *Nineteenth Century* —reflecting the consensus of European opinion: "America, as one would expect, has been the classic home of all that is hasty, negligent, and well-nigh criminal in the misuse of oil as of every form of natural wealth; and America in consequence finds herself today consuming more oil than she produces". . . . "What does that simple fact mean?" asks Dr. J. E. Pogue and answers: "It means that we must pay growing attention to all methods, engineering and economic, that will conduce to the fuller utilization of the raw material we have."

The oil industry has now the obligation to satisfy the most important, vital needs of modern civilization. If greed, ignorance, recklessness and what not, brings it, and with it the well being of the country, to a fall; if the exhaustion of the petroleum supply is so near; if its use and misuse is no longer a matter of private, but public, national concern, what policy should this great commonwealth pursue? Certainly the case for public intervention is stronger than for intervention in the business affairs of minors, incompetents and wastrels who squander merely personal fortunes.[6]

In answer to the foregoing criticisms *The Oil and Gas Journal* speaking for the industry, displays another viewpoint back of which is a different theory of value. The first critics base their criticisms on a utility theory of value, while the oil industry replies with an exchange theory of value. Exchange value is the relative scarcity value of two things. In this case the relationship exists between money and oil.

5. Leo Pasvolsky, "Civilization and Oil," *Atlantic Monthly,* February, 1923, p. 267 ff.
6. Walter N. Polakov, "Oil," *The New Republic,* June 14, 1922, p. 68.

Our critics forget that the industry is more interested in assuring our future of oil than any one else possibly can be because the industry must have oil to continue in business. The eleven billion dollars invested in the oil business is not concerned only with drilling wells and producing oil. Back of that are the immense pipeline systems, the great fleet of tankers, the 150,000 tank cars, the vast refineries that dot the coasts and spread over the interior, the 165,000 service stations and nearly 100,000 gasoline pumps, with all the necessary appurtenances connected with the marketing of petroleum products throughout the country and the world.

Waste of our crude oil reserves would hasten the disappearance of all this investment unless a substitute were found to serve as a marketable motor fuel. Is it reasonable to assert that an industry so dependent upon its raw material is willfully wasting it?

If it has overproduced oil it was because it has felt that it was powerless to prevent it under our laws which seemed to prohibit the co-operation that alone could check that overproduction.[7]

As the supply of oil increases its utility decreases or, in other words, as scarcity of oil diminishes its utility also diminishes. The critics, therefore, have the same purpose as those within the industry. The outsiders desire to see this resource conserved to satisfy the higher wants of this and future generations, while those within the industry, which is no different from any other industrial enterprise in our present money economy, desire a limitation on production because it increases scarcity, thus increasing profits. Economic value is a functional relation between use value and scarcity value. As the supply of petroleum is decreased it is reserved for higher uses, thus bringing about higher prices. So what President Coolidge evidently meant by essential value was what the economist calls economic value.

Professor John Ise criticises the industry because it is satisfying "twenty-cent" wants when oil might be saved to satisfy a "fifty-cent" want. "Billions of gallons of gasoline and lubricating oil consumed in senseless joy-riding represents largely waste."[8] It would be futile here to enter into a discussion of the relative importance of human wants. A ten-cent want to some, may be a dollar-want to others. While it must be admitted that we have certain obligations to posterity it is debatable whether their wants will be any higher than ours even at the present rate of production and our present known supply. Mother Necessity more likely than not will take care of them. The laboratory has always anticipated the factory.

Professor Ise's criticism is purely from the utility viewpoint. It must be remembered that civilization, customs, and habits of the people change use values. Wants of today are not by any means the wants of tomorrow. Use value is subjective and changes from time to time and place to place. It is just as possible that more waste would result should we deny ourselves to the fifty-cent wants at the expense of the cheaper wants.

7. "Let the Industry Do It," an editorial in *The Oil Industry's Answer Today*, p. 2. Reprinted from the December 1, 1927, issue of *The Oil and Gas Journal*.
8. John Ise, *The United States Oil Policy*, Yale University Press, p. 176.

What the oil industry and society are concerned with is the elimination of economic waste. Economic waste is when the economic value of the good produced is less than the cost of producing it. The waste is the difference between the cost and the return. Cost is understood to mean here the economic value of labor and capital put into the industry, and return, to mean the economic value of the oil produced. When any reference is made to waste in the following pages it will carry the foregoing meaning unless otherwise specified. It might be suggested here that the value of the oil recovered is often greater than the costs incurred in obtaining it but at the same time a waste results from the inefficient methods of recovery in leaving considerable quantities in the sands. The contention is well taken that there is economic waste. The problem must not be viewed from the standpoint of the individual operator but from a social viewpoint; it must include the total costs and the total returns. Still, the question might be asked, if the total returns are greater than the total costs and there is considerable oil left, yet, due to inefficient methods of recovery, would that be waste? It would be waste if later attempts to recover it would result in total costs greater than total returns, or if the same amount of labor and capital employed in creating substitutes for the petroleum left would result in a lower return.

No one will deny the existence of waste. The leaders of the industry, the federal government, and the governments of the respective states in which oil is produced are all concerned with the problem, not to mention the public generally which is largely unaware of its importance. An attempt will be made in the succeeding chapters to estimate the extent of this waste and discuss the efforts being put forth to eliminate it.

The antidote to waste is conservation. The word conservation, like the word waste, carries many meanings. For example, conservation in production may mean production of less crude oil, while conservation in refining has reference to the production of more gasoline. It is the efficiency of the industry that has brought about this state of affairs. Efficiency is the rate of output to the unit of labor and capital (output here has reference to use value). Labor and capital create use values. Resistance to labor creates scarcity values. The industry through its efficiency has created too large a volume of use values while scarcity values have been diminished. It may be called to mind that economic value is the functional relationship between these two. Economic value increases directly with scarcity value and indirectly with use value, the other factor remaining the same. Conservation is the preservation of economic values. This does not imply necessarily that efficiency must be lowered. The number of units of labor and capital may be reduced. Use values change, which fact has a great deal to do with conservation. While scarcity was defined above as the resistance to

labor this resistance may be brought about in four ways: increase in wants, niggardliness of nature, increase in production costs, and monopoly. These factors as they apply to the oil industry are listed in the order of their importance. There is a bigger gap between the last two factors than between the first and second, and second and third.

Professor Van Hise has taken conservation to mean "the greatest good to the greatest number—and that for the longest time."[9] M. L. Requa has amplified this definition by quoting:

> True conservation is not hoarding, but the wise use of natural resources; and it implies not merely the preserving in unimpaired efficiency, but also a wise and equitable exhaustion with a maximum efficiency and a minimum waste. Conservation, therefore, takes cognizance of equitable distribution; aims to bring about social justice, and means the greatest good to the greatest number—and that for the longest time.[10]

Secretary Work in his annual report as secretary of the interior for the fiscal year of 1925 said that "conservation concerns the perpetuation of the human family by making intelligent use of what nature provides."

Let us briefly consider these definitions. Few would take exception to them as far as their wording is concerned. Many would disagree, however, over the method of obtaining "the greatest good to the greatest number." The *laissez faire* economists thought the utilitarian philosophy of the greatest good to the greatest number could be achieved by each individual seeking his own selfish ends. Under a legal system colored by this same philosophy the oil industry has been compelled to follow this policy, which has brought about the present state of affairs. In Mr. Requa's definition there is a wide variation in opinion as to what constitutes a wise use of natural resources. What constitutes a wise and equitable exhaustion? In Mr. Work's definition what constitutes an intelligent use of what nature provides? It is questions like these that complicate the problem. They can never be answered with complete satisfaction because of the multiplicity of conflicting motives and the predominance of self interest. These are economic questions of the highest significance but they will never be settled by economists unless the judge has the happy combination of being both economist and lawyer. Courts eventually will settle these questions, which cannot be answered dogmatically. What constitutes a wise and equitable exhaustion at this time and in this place may not be wise and equitable at that time and at that place. What may be an intelligent use once may prove entirely the converse at another time or situation.

There remains the question: What is meant by stabilization of production?

9. Charles R. Van Hise, *The Conservation of Natural Resources in the United States*, the Macmillan Company, New York, 1913, p. 379.

10. M. L. Requa, "Oil Leaders Strive to Check Wasteful Flow" in the *New York Times*, April 7, 1929.

Production has two meanings. To the engineer it means the creation of use values. To the oil industry it means the taking of oil from the place where it is found in the ground to where it can be used. Frequently this act is called the recovery of oil, but recovery is not apposite, because it means to gain something that is lost. It may be said that oil has been recovered once it has been regained after having been lost. In contrast to the engineer's understanding of production as use value is the economist's, the creation of scarcity values. To the economist, it means withholding goods in such limited quantities that their scarcity values, compared with the scarcity values of both the goods that compose the costs and the goods for which they are sold, will leave a profit.

At the present time the industry is more concerned in the stabilization of production from the economist's viewpoint than from the engineer's. The engineers have performed their service well. They have succeeded in creating a superabundance of use values.

Stabilization today does not mean the control of prices. It does not mean the guarantee of profits to the marginal operators. Stabilization means the withholding of sufficient quantities of oil so that the scarcity value of that obtained when compared with the total scarcity values of the goods which compose the costs employed by the industry as a whole to the total goods for which they are sold by the industry will leave a profit. Stabilization means the reduction of uncertainty to certainty. At the present time the problem of stabilization is the control of supply, not to obtain exorbitant prices, but to insure a reasonable profit to the industry as a whole on the capital invested.

The next five chapters will be devoted to a description of the petroleum industry, the nature of crude oil and its occurrence, and some of the most important economic aspects of the industry in order to bring into clear relief the magnitude of the problem and a better understanding of the plans for its solution.

CHAPTER TWO

THE PETROLEUM INDUSTRY

THE spread of higher living standards has been characteristic of American economic life practically throughout the history of the country, as it has been in other countries to a more or less degree. Recent economic developments in the United States are the result of acceleration rather than of structural change. The factors that have contributed to this acceleration are not new: Invention is not new; transportation and communication have been a service always to civilization; competition has been a characteristic of previous eras. The distinctive characteristics of modern economic life are intensified activity, the increased supply of power and its wider uses, uses which have risen three and three-quarters times faster than the growth of population, and the scientific division and arrangement of work in mines and factories, farms and trades, so that the production has reached levels never before attained to the man hour of effort. This tendency in the seven year period between 1922 and 1929 has been accelerated greatly.[1]

The petroleum industry has kept pace with this march of progress. If speed is the chief characteristic of this age, it is petroleum that has made speed possible, economically as well as mechanically. Petroleum is practically the sole lubricant of the world today. Rarely does a wheel turn without petroleum having been used. From the most delicate mechanisms to great turbines, they move on surfaces smoothed by petroleum.

Lubrication, light, and fuel are three primary essentials to civilization and petroleum provides all three.

Early Uses of Petroleum

Since the most remote times man has used petroleum. Early Egyptians embalmed their dead with it. There are more than two hundred references in the Bible to the use of oil, pitch, and slime. Noah used asphalt, a residue from crude petroleum, to waterproof the Ark. The early Chinese and Japanese were acquainted with its uses for lighting and heating. It was the object of worship by the ancient "fire-worshippers" of Persia. Herodotus describes the oil pits near Babylon and the pitch springs near Zante in his writings. In 1436, in Bavaria, and, in 1506, in Galacia, oil was used for its medicinal properties.

Marco Polo wrote:

Bordering the province of the Georgians by the side of Aquilonai there is a great fountain which constantly gives out a liquid like oil that for cooking and eating is bad but

1. National Bureau of Economic Research, Inc., *Recent Economic Changes in the United States,* 1929, McGraw-Hill Book Co., Vol. I, pp. ix-xxi.

for light and other functions is useful. They come here from different nations in the vicinity to provide themselves with this oil that is used to light their houses and it is in such way that they come from other remote places to provide themselves.[2]

History does not record when oil was first used in the Americas. The Indians had known for a long time its medicinal properties. Sir Walter Raleigh probably made the first recorded reference to petroleum in the western hemisphere when he mentioned the pitch lake of Trinidad in 1595. Thirty seven years later Joseph de la Rochelle d'Aillon mentioned the oil springs of New York in his chronicles. A Russian traveler, Peter Salm, in a book on America, published in 1748, showed a map of the oil springs of Pennsylvania.

The account of F. Cummings in 1807 is very interesting in affording a contrast to modern production methods.

The mode of collecting is this; the place where it is found bubbling up in the creek is surrounded by a wall or dam to a narrow compass. A man then takes a blanket, flannel or woolen cloth to which it adheres, and spreading it over the surface of the inclosed pond, presses it down a little, then draws it up, squeezes out the oil into a vessel prepared for the purpose; thus thirty gallons of pure oil can be obtained in three days by one man.

He said in another place that this oil sold from one dollar and a half to two dollars a gallon. A standard barrel of oil contains forty-two gallons. At this rate oil sold from $63 to $84 a barrel as compared to Pennsylvania oil today selling at an average of $3.00 a barrel.[3] George Washington, while surveying a grant of land near the mouth of the Great Kanawha, given to him for military services, became interested in the "burning springs" located near and made mention of them in his diary.

Pittsburgh was an early market for this commodity. Oil was usually carried there in two five gallon kegs, one tied on each side of a horse, and taken overland a distance of about seventy-five miles. It was sold principally to apothecaries who retailed it in smaller quantities at higher prices.

During this period crude petroleum was frequently called "Seneca Oil" and distributed widely for its medicinal properties. Samuel M. Kier bottled the crude product in eight ounce bottles. He sent out literature rivaling that of our modern patent medicine companies in its appeal describing petroleum's gifts and curative powers.

Other uses were soon to be found for petroleum. The world was wanting more light because the reading habit was increasing at this time. For centuries man had been depending on animal and vegetable oils. In south Europe refined olive oil was used for illuminating purposes and in

2. Marco Polo, *History of the Greatness and Wonderful Things in the Oriental Provinces,* Translated from the Latin by Martin de Bolea, Tavano, 1601, Saragosa, Spain, Book I, Chapter 13.

3. Supplement to *The Oil and Gas Journal,* May, 1920.

northern Europe and in America whale oil and the tallow candle were used. The demand for whale oil increased in the nineteenth century until these mammals of the sea became almost extinct. It was a happy coincident, therefore, that abundant petroleum was found and the art of using it came to America in time to prevent a return to the gloom of the pine knot and tallow candle.

Early attempts were made to produce illuminating oils and lubricants from coal and shale by distillation. In 1746, Murdoch laid the foundation of the present coal gas industry and a hundred years later Gessner manufactured an illuminant from the albertite of New Brunswick and called it kerosene. The older name, coal oil, is common to this day.

The extraction of oil from shales was followed with more or less success in Southern France, Saxony and Scotland during the first half of the last century until the keen competition of the more cheaply manufactured petroleum overshadowed it.

Beginning of Modern Petroleum Industry

The birth of the modern petroleum industry in America dates from August 27, 1859 when the first well drilled for the purpose of finding oil was brought in at Titusville, Pennsylvania, by Col. E. L. Drake, superintendent for the Seneca Oil Company. It is very fortunate, indeed, for the industry that the location was made where it was. Oil was found at a depth of only sixty-nine and one-half feet. Had not oil been found at such a shallow depth the probabilities are that the development of the industry would have been postponed for some time, since Colonel Drake and his company were at the end of their financial resources. They would have been forced to abandon the well had it been necessary to drill deeper. Drilling for oil was only an experiment and few were willing to risk their capital in such an enterprise. The initial production of the Drake well was forty barrels a day with a pump. It soon settled to a daily average of fifteen barrels. Fifty cents a gallon was the price received for it.

The second well drilled in this district was by Rouse and Mitchell in December of the same year. The first sand gave only eight barrels a day so it was drilled to a third sand that produced three hundred barrels daily. Like many other industrial pioneers as well as inventors, artists, and scientists, Colonel Drake died a poor man and the economic exploitation of his discovery fell very easily and naturally into the hands of a more acquisitive group.

The oil business began in earnest in 1860. The Civil War did not check its beginning nor stunt its early growth. There has always been an element of the spectacular in the oil industry. Many inventions had been devised by 1872. Two hundred million dollars had been invested in the business and it was supporting a population of sixty thousand.

The early towns of Pennsylvania went through all the experiences characteristic of the boom towns of modern days. They caught the back wash of humanity and its attendant vices. From time to time there still appear in the current trade journals stories recalling the exploits of "Coal Oil Johnnie" whose antics were no worse, although probably more spectacular, than some of the *nouveau riche* from the oil fields of today.

The production of oil in 1859 approximated 2,000 barrels. In 1860 the production increased to 500,000 barrels.[4] This sudden increase in the supply of oil demoralized the markets. The public soon was convinced, however, that this new source of illumination was permanent, so the use of petroleum spread rapidly. Refineries sprang up, but they were inadequate to meet this new demand. By 1870 two hundred and fifty refineries were in operation, spread from Louisville, Kentucky, to Portland, Maine. The oil fields in Pennsylvania became congested with population. Oil first was transported from the well to the railways on the Allegheny river at Oil City in wagons drawn by teams. Early transportation in the petroleum industry seen in perspective is interesting—the confusion, mud, waste, swearing, fighting. Traffic down the Allegheny river soon assumed large proportions. Oil was carried down this stream in barrels loaded on flat boats. Frequently there were shortages of barrels which resulted in embarrassment to shippers. The traffic employed a thousand boats, thirty steamers, and between three and four thousand men. Pipelines, crude compared with those today, were eventually built from the fields to the shipping points. The coming of the pipelines displaced the teamsters who did not give up without a struggle.

John D. Rockefeller in 1865 began to refine petroleum in a small way. The problem confronting refiners in those days was that of finding adequate capital. Refining technology was in its infancy. In 1866 a more efficient cylinder still was invented. In 1867 through his influence Rockefeller consolidated the refineries of William Rockefeller and Company, Rockefeller and Andrews, Rockefeller and Company, S. V. Harkness and H. M. Flagler. Thus he combined their skill and capital to form a unit of sufficient size and strength to meet increasing demands made upon the industry in general.[5]

The first period of the petroleum industry came to an end with the reorganization of the firm, Rockefeller, Andrews and Flagler, in 1870 into the Standard Oil Company of Ohio with a capital stock of $1,000,000. Although this company was engaged only in the refining of petroleum and in the marketing of its products it has had a far reaching influence on all branches of the industry.

4. See Table I, Appendix.
5. Report of the Industrial Commission, 1900, Part 1, p. 95.

Influence of the Standard Oil Company

The history of the oil industry from 1870 to 1911 is centered around the Standard Oil Company. It has maintained a dominating position since its beginning.

There are several reasons for its leadership. The first is due to the ability of the men themselves who controlled the organization. This was brought out in the testimony of William H. Vanderbilt before the Hepburn committee.

Question. Can you attribute, or do you attribute in your own mind, the fact of there being one refiner instead of fifty now to any other cause except the larger capital of the Standard Oil Company.

Answer. There are a great many causes: It is not from their capital alone that they have built up this business. There is no question about it but that these men—and if you come in contact with them I guess you will come to the same conclusion I have long ago—I think they are smarter fellows than I am, a good deal. They are very enterprising and smart men. I never came into contact with any class of men as smart and as able as they are in their business, and I think that a great deal is to be attributed to that.

Q. Would that alone monopolize a business of that sort?

A. It would go a great ways toward building it up. They never could have got in the position they are in now without a great deal of ability, and one man would hardly have been able to do it; it is a combination of men.

Q. Wasn't it a combination that embraced the smart men in the railways as well as the smart men in the Standard company?

A. I think those gentlemen, from their shrewdness, have been able to take advantage of the competition that existed between the railroads for their business, as it grew, and that they have availed themselves of it there is no question of doubt.

Q. Don't you think they have also been able to make their affiliations with railroad companies and railroad officers?

A. I have not heard it charged that any railway official had any interest in any of their companies, only that I have seen in the papers, some years ago, that I had an interest in it.

Q. Your interest in your railway is so large a one that nobody could conceive, as a matter of personal interest, that you would have an interest antagonistic to your road?

A. When they came to do business with us in any magnitude that is the reason I disposed of my interest.

Q. And that is the only way you can account for the enormous monopoly that has grown up?

A. Yes; they are very shrewd men. I don't believe that by any legislative enactment or anything else, through any of the states or all of the states, you can keep such men down. You can't do it! They will be on top all the time. You see if they are not.[6]

The second reason for the success of the Standard Oil Company is the momentum of an early start. By taking advantage at the very beginning they were able to locate refineries at the best places, to accumulate experience and data necessary to the successful conduct of the business.

The third reason may be attributed to the fact that the oil industry came into being about the time the railroads were beginning their programs of ex-

6. Report of the Hepburn Investigating Committee, New York, 1879, p. 2605.

pansion. The railroad business at this time was highly competitive. The roads had spread into Pennsylvania, Ohio, Illinois, and Indiana faster than the territory could provide sufficient business for them. Competition was keen for all available business and the rapidly growing oil industry was an attractive source of income. Naturally the strongest companies could command the best rates. The Standard Oil Company took advantage of the situation by securing preferential rates and rebates thus entrenching itself more strongly than ever.[7]

The control of pipeline transportation is a fourth factor contributing to the dominant position of this company. Control of pipelines was secured in various ways: By obstructing the building of pipelines by competing concerns; by blocking their rights-of-way and litigation; by obtaining control of other concerns by purchasing control of their stock; by paying premiums on crude oil at the wells to producers in the vicinity of independent pipelines; by refusing to transport oil either by direct methods or indirect methods for other than Standard refineries.[8]

The fifth factor may be attributed to the prevailing standard of ethics, or better say, the absence of a standard of ethics. In this period of industrial development in the United States business relations were not conducted on very high levels. The leaders of the Standard Oil Company were probably no more unscrupulous, according to present standards, than the leaders of other enterprises.

They carried on their business according to the current practice but being shrewder than their contemporaries they outwitted them. The prevailing methods of cut-throat competition were employed by this company. These methods are not endorsed today by industrial leaders, not even by the leaders of the Standard Oil group, but at that day and time it was necessary to resort to them for self-preservation. By the skillful application of these tactics the Standard Oil Company forged ahead, tactics that later brought the company into the courts and made the industry one of the most susceptible even to this day, for public investigations.

The Standard Oil Company escaped the fate that befell many of its competitors and was not stunted in its early growth by the depression of 1873. The annual production of oil had increased from 5,261,000 barrels in 1870 to 10,927,000 barrels in 1874. In 1873 on account of overproduction a severe depression in the industry occurred. Because of superior economies in re-

7. Gilbert Holland Montague, *The Rise and Progress of the Standard Oil Company,* Harper and Brothers, New York, 1903; Ida M. Tarbell, *The History of the Standard Oil Company,* 2 vols., McClure, Phillips and Company, New York, 1904; Bureau of Corporations, *Report of the Commissioner of Corporations on the Petroleum Industry,* 2 vols., Washington, 1907.

8. Bureau of Corporations, *op. cit.,* Part 1, pp. 25 and 26.

fining and its favored position in securing lower freight rates the company did not suffer from the severe effects of the depression as did its competitors. It took advantage of the situation and bought up the weak refineries. By 1879 it controlled ninety-five per cent of the refining business. Although the Standard Oil Company was primarily a refining and marketing organization, by reason of its superior position, it was able to influence production. In 1875 production was reduced to 8,788,000 barrels.

It is appropriate at this place to give John D. Rockefeller, sr.'s own reasons for the success of the Standard Oil Company:

> Question. To what advantages, or favors, or methods of management do you ascribe chiefly the success of the Standard Oil Company?
>
> Answer. I ascribe the success of the Standard to its consistent policy to make the volume of its business large through the merits and cheapness of its products. It has spared no expense in finding, securing, and utilizing the best and cheapest methods of manufacture. It has sought for the best superintendents and workmen and paid the best wages. It has not hesitated to sacrifice old machinery and old plants for new and better ones. It has placed its manufactories at the points where they could supply markets at the least expense. It has not only sought markets for its principal products, but for all possible by-products, sparing no expense in introducing them to the public. It has not hesitated to invest millions of dollars in methods for cheapening the gathering and distribution of oils by pipelines, special cars, tank-steamers, and tank-wagons. It has erected tank stations at every important railroad station to cheapen the storage and delivery of its products. It has spared no expense in forcing its products into markets of the world among people civilized and uncivilized. It has had faith in American oil, and has brought together millions of money for the purpose of making it what it is, and holding its markets against the competition of Russia and all the many countries which are producers of oil and competitors against American oil.[9]

The original trust agreement of the Standard Oil Company was formed in 1882. The Standard Oil Company has often been cited as the most classic example of trusts formed in this era of industrial history of the United States, when so many trusts were organized. This condition was the result of the general economic conditions prevailing at the time. Earlier industrial development of the United States emphasized production. For many years there was a market ready to absorb all that was produced. In order to meet what seemed an insatiable demand new land was brought into cultivation, new resources discovered, new devices and inventions were brought into use, and schools were established to train more technicians in order that more goods might be produced. In the latter part of the eighties, and in the nineties, production began to catch up with consumption, resulting in keen competition, not only for domestic but foreign markets as well. The problem then was one of getting the market to absorb the goods that could be brought to it. The purchasing power of the consumer had not grown as rapidly as the ability of industrial society to produce. It is natural, then, that one of the

9. Industrial Commission Report on Trusts, 1900, Vol. I, p. 796.

first things to happen would be for the business firms in the various industries to combine, in order to eliminate the competition so ruinous to business prosperity. The Standard Oil Company was one of the first to form such a combination, setting a pattern for others to follow. Before many years had passed the same thing happened in nearly every other major industry. The names, "Standard," "American," "National," and "United," were the most common adopted by these combinations. It might be said in passing that the trust movement was not the only one, but such institutions as national advertising were emphasized, in order to stimulate a greater demand for goods. It soon became evident that the company that could put its products on the market at the lowest cost could best survive the severe competition. The Standard Oil Company was not long in recognizing this principle, and the refineries of this organization were among the first to employ scientific methods in manufacture and management.

The Standard Oil Company was dissolved in 1892 because the court held that the trust agreements in question are acts which must be regarded as the acts of the corporation, and, as such *ultra vires;* and tending as they do to the creation of a monopoly, to the control of prices as well as of production, these acts are also against public policy, and accordingly contrary to law. This same year the Standard Oil trust was dissolved and the various establishments and plants reorganized into twenty constituent companies. The trust certificates, when they were surrendered, were replaced by a proportion of the shares of each company, properly divided. The effect was the same as before and the men who were trustees held a majority of the stock. The unity of action among the several companies was not changed.[10]

This organization continued to function until 1911, when the Standard Oil Company of New Jersey, a holding company, was dissolved by the United States Supreme Court. This corporation was broken up into thirty-three separate and independent companies. Out of the thirty-three companies, eleven were marketing organizations. After the dissolution, these companies continued to do business in their respective territories. The effect of the dissolution decree is described in a report of the United States fuel administration, as quoted in Pogue's *Economics of Petroleum.*

> One of the immediate and permanent results of the application of this principle was to limit the interest of the executives of the new commercial entities to market values in the territory in which they operated. The factor which had worked to exert national rather than sectional influence upon the trend of the markets and to establish a general level of prices for petroleum products, subject only to transportation and similar normal variations, had been wiped out of existence. The fragments which had formerly constituted the Standard Oil Company, New Jersey, were then found, in their new corporate form, to be

10. 7 *Harvard Law Review* 348.

unable separately to perform the service to the public which had been accomplished by the complete organization. Many of the units were without the equipment both to manufacture and distribute petroleum products in the territory in which they operated at the time of the court decree. Some of them, formerly merely marketing subsidiaries of the original corporation, were now faced with the necessity of finding new sources of supply. The corollary to this was that those units which in the general scheme had been devoted principally to the refining of oil found that new markets for their output were the first essential to their existence.

It is no reflection upon the high purpose and public zeal which brought about the attempt at government control to say that experience has shown that action to be an economic mistake and that the new order which it established accentuated rather than retarded the conditions which it was designed to correct. This development has not been the outcome of lax or unintelligent enforcement of the dissolution order, for the weight of evidence accumulated as the result of keen and almost constant surveillance by several departments of the government is entirely in support of the conclusion that the dissolution decree has been scrupulously observed.

The separate units do not compete, but, in general, limit their activities to the territory in which they were operating at the time of the decree in the Standard Oil case. The active competition of two or more of them for business in the same territory would have much the same effect on outside competitors as a combination between them to suppress competition, and might well create the suspicion that this was the purpose. By not invading each other's territory they perhaps would follow the only practical course to avoid charges of collusion and of attempts to evade the decree in the dissolution suit. These units trade with each other in conformity with the law, but after eight years the dissolution decree has been found neither to have destroyed nor lessened the influence of the so-called Standard Oil companies in their respective territory. It has simply proved that legislation can not change the operation of economic laws.

The admitted efficiency which characterized the original corporation was not removed by the dissolution decree and is still in evidence in the detached organizations.

The advantage of large cash reserves, the possession of strategic commercial locations, the experience gained from acquaintance with the industry virtually since its inception, have all contributed to maintain the position of this particular group and to continue its influence upon markets and prices. After eight years of operation under the dissolution decree, the premier position and influence of the Standard group remains unquestioned. The present situation conclusively demonstrates that legislation cannot change the working out of fundamental economic principles.[11]

A decade has passed since the publication of this report. Many changes have taken place in the Standard group since then. All companies today that were a part of the dissolved organization, or subsidiary thereto, are known as "Standard" companies. All other companies are called "Independents." Many large independents have been taken over through merger, or otherwise, by units in the Standard group. Some of the independent companies have developed into corporations of considerable size and today are larger than some of the larger companies in the Standard group. Table I shows the investment (capital stock, bonds, serial notes, and surplus) for 1911, 1925, and 1926 of twenty companies having an investment of $100,000,000 or over.

11. Joseph E. Pogue, *Economics of Petroleum,* John Wiley and Sons, New York.

Reference to the table shows that five large independent companies, namely, the Sinclair Consolidated Oil Corporation, the Shell Union Oil Corporation, the Empire Gas and Fuel Company (Delaware), the Pan-American Petroleum and Transport Company, and the Phillips Petroleum Company, were formed after December, 1911, when the Standard Oil dissolution became effective.

TABLE I

Investment of twenty petroleum companies having an investment of $100,000,000 or over in 1926, for 1911, 1925, and 1926.[12]

Company		1911	1925	1926
Standard Oil Co. of New Jersey	(1)	$292,000,000	$1,063,903,806	$1,264,161,247
Standard Oil Co. of New York		75,955,736	480,445,402	629,072,475
Standard Oil Co. of California		39,213,195	514,140,342	543,697,627
Standard Oil Co. of Indiana	(2)	25,217,405	368,383,842	402,835,977
Sinclair Consolidated Oil Cor.		(3)	328,428,185	336,308,361
The Texas Company	(4)	43,602,995	277,916,023	292,812,541
Empire Gas & Fuel Co. of Delaware		(3)	(5) 254,036,792	(5) 284,914,914
Gulf Oil Corporation of Pennsylvania		25,363,095	260,633,349	284,645,433
Shell Union Oil Corporation		(3)	243,583,000	253,666,793
Pan American Petroleum & Trans. Co.		(3)	169,957,530	234,233,941
Tide Water-Associated Oil Co.		70,660,742	208,068,159	215,567,834
Union Oil Co. of California		71,032,422	150,306,327	183,940,657
Pure Oil Co.		10,337,932	(6) 167,671,940	(6) 168,890,149
Humble Oil & Refining Co.	(7)	(3)	119,577,597	160,161,367
Prairie Oil & Gas Co.	(8)	53,915,176	139,435,262	150,962,163
Vacuum Oil Co.	(9)	24,167,478	133,014,762	131,170,684
Atlantic Refining Co.	(10)	15,965,748	121,688,578	121,274,910
Prairie Pipe Line Co.		(3)	104,971,903	112,955,936
Phillips Petroleum Co.		(3)	91,177,853	105,367,160
Ohio Oil Co.	(10)	44,051,447	96,144,569	101,312,431
TOTAL		$791,483,371	$5,293,485,221	$5,977,952,600

(1). "High cost of gasoline and other petroleum products," p. 193, hearings before a subcommittee of the committee on manufactures, United States senate, sixty-seventh congress, second and fourth sessions.
(2). *Ibid.*, p. 768.
(3). Not in business in 1911.
(4). June 30, 1911.
(5). Year ending November 30.
(6). Year ending March 31.
(7). Controlled by Standard Oil Company of New Jersey.
(8). Includes investment in Prairie Pipe Line Company.
(9). Includes $8,238,443 due Standard Oil Company of New Jersey.
(10). Computed from statement for December 31, 1912.

The investment of the other five independents was increased from 1911 to 1926, as follows: The Texas Company, 572 per cent; the Gulf Oil Corporation, 1,022 per cent; the Tide Water-Associated Oil Company, 205 per cent; The Pure Oil Company, 1,534 per cent; and the Union Oil Company of California, 159 per cent. The investment for 1911 for the Tide Water-Associated is the combined investment of its predecessors, the Tide Water Oil Company and the Associated Oil Co. Of course there are many independent

12. Federal Trade Commission, *Petroleum Industry—Prices, Profits and Competition*, Senate Document No. 61, Seventieth Congress, first session, 1928, p. 61.

companies with an investment of less than $100,000,000 that have experienced a rapid growth.

The twenty companies listed above had an aggregate investment of $5,293,485,221 in 1925 and of $5,977,952,600 in 1926, a gain of 12.9 per cent. Of this aggregate the Standard companies had $3,141,706,063 or 59.5 per cent in 1925 and $3,617,604,817 or 60.5 per cent in 1926.

The distribution of its stockholdings in most of its subsidiaries which was made in 1911 in compliance with the dissolution decree resulted in a marked decrease in the Standards's of New Jersey investment. On December 31, 1906, soon after the dissolution suit was brought, its investment was $359,400,000, while on December 31, 1911, immediately after stock in most of the subsidiaries was distributed ratably to stockholders, it was only $292,000,000. From the end of 1911 to 1926 its investment increased 333 per cent.

The Standard Oil Company of New York ranked third in size of investment in 1925 and second in 1926. On May 18, 1926, it acquired the General Petroleum Corporation, an important producing, refining, and marketing company operating in the Pacific coast territory.

The Standard of New York had an investment of $629,000,000 at the close of 1926, a gain of thirty-one per cent over December 31, 1925, and of 728 per cent over December 31, 1911.

The Standard Oil Company of California ranked third among all of the oil companies of the country in the size of its investment on December 31, 1926. It increased from about $39,200,000 at the end of 1911 to almost $543,700,000 on December 31, 1926, or 1,287 per cent. This great increase was partly due to the acquisition of the Pacific Oil Company in 1926.

The Standard Oil Company (Indiana) ranked fourth December 31, 1926 with an investment of over $402,800,000, as compared with $25,217,000 December 31, 1911. This represents a gain of 1,497 per cent.

The Prairie Oil and Gas Company was engaged in the production and pipeline transportation of crude petroleum before 1906, but, effective January 1, 1915, its pipeline business was taken over by the Prairie Pipe Line Company, hence the consolidation of the investment of the two companies as of December 31, 1926, shows its growth more accurately than by comparing its own investment. On that basis the investment was increased from about $53,900,000 December 31, 1911, to over $263,900,000 on December 31, 1926, or a gain of 390 per cent. The Prairie Pipe Line Company is the only pipeline company in the entire country with an investment in excess of $100,000,000.

The Tide Water-Associated Oil Company represents a recent merger of the Tide Water Oil Company with the Associated Oil Company.

At the end of 1911 the combined investment of the Tide Water Oil Company and the Associated Oil Company was $70,660,742 as compared with $215,567,834 in 1926, a gain of 205 per cent.[13]

Contrasted with the report of the United States fuel administration on conditions prevailing in the industry in 1919 is the report of the federal trade commission in its letter of submittal to the president of the senate, December 12, 1927, on prices, profits, and competition in the petroleum industry. Excerpts from the letter disclose a considerable change has taken place.

They state:

Less than twenty years ago one company, which was absolutely controlled by a very small group of men, completely dominated the petroleum industry and determined the prices of both crude petroleum and the refined products. Since then great changes have taken place in the organization and importance of many companies and in their relations to one another and to the industry as a whole. This has been due partly to the separation of most of the subsidiaries of the Standard Oil Company of New Jersey from this holding company in 1911, as a result of a judicial decree under the anti-trust acts and partly to the great expansion of the industry through new and extremely productive fields of crude supply and through new and well-nigh insatiable demands for gasoline for motor cars. . . . .

All of the separated Standard companies in the aggregate now have about twenty-five per cent of the crude production and about forty-five per cent of the output of refined products. They had about eighty per cent of refined products twenty years ago. Considering all the large companies, both Standard and independent, each of eleven refining companies now uses more than two per cent of the total crude refined in the United States. Five of these companies have evolved from the dissolution of the old Standard combination, and their combined consumption is nearly forty-two per cent of the total; the consumption of the six independent companies is roughly twenty-five per cent each. In the marketing of their refined products the independent companies sustain roughly the same relation to one another and to the whole as in the refining business. About half of the crude is still produced by a very large number of individuals or small companies, but more than two-thirds of the "proven acreage" of oil-bearing lands of the country is in the hands of nine Standard companies and the six independent companies to which reference is made above. . . . . .

The inquiry disclosed with respect to company management that 179 directors hold 458 directorships in companies covering seventy per cent of the industry, aside from the production of crude, but only four instances were reported of interlocking of directorates such as would have an appreciable tendency to unify the control of any considerable part of the industry.

The controlling ownership of the several Standard Oil companies which, after the dissolution decree was put into effect in 1911 rested in the hands of three or four individuals, has been widely dispersed. So far as this factor is concerned there is no longer unity of control of these companies through community of interest. Among different companies this community of interest varies widely, and is largest among the pipeline companies.

Of nearly 10,000 reported large stockholders in all reporting companies only 163 were found to have as much as one per cent or more of the voting stock of each of two or more companies, and only twenty-two of these were holders of stock in potentially competing

13. Federal Trade Commission, *op. cit.*, pp. 61-62.

large groups. With respect to five individuals and eleven other holders, each of them had more than one per cent of the voting stock of the controlling companies in two or more of the Standard groups, and each of six brokerage houses held more than one per cent of the voting stock of both Standard and independent companies. None of these holdings, however, appears to have any especial significance with respect to control. No individual reported as the holder of one per cent or more of two Standard companies is reported as an officer or director of any company in the petroleum industry.

The Standard marketing companies continue in general to confine their tank-wagon sales to retailers and their filling station business to the separate territories assigned to them before the combination was dissolved, but there are now numerous exceptions to this rule. Thus the Standard of New York and the Standard of California compete for such business on the Pacific coast. In Texas and Arkansas the Standard of New York likewise competes with the Standard of New Jersey. The Standard of Indiana through a recently acquired subsidiary is now in competition with the Standard of New Jersey, the Standard of New York, the Standard of Kentucky, and other instances might be cited.

Moreover some of the largest Standard companies hold themselves ready to sell gasoline in tank-cars to jobbers without restriction as to the territory of resale, thus making it possible for the independent jobber to re-sell in competition with them. Some of them also sell in tank-cars outside of their regular marketing territories. The number of independent jobbers is very large and is rapidly increasing.[14]

Press dispatches of January 9, 1930, carried the announcement of the offer of the Standard Oil Company of New York to acquire the White Eagle Oil and Refining Company. This may be regarded as an indication of a further breaking down of rigid marketing areas of the old Standard Oil organization. The White Eagle, with its subsidiary, Nicholas Oil Company of Omaha would give the Standard of New York outlets in Nebraska, the Dakotas, Kansas, Colorado, Minnesota, Wisconsin, Missouri, Utah, Montana and Wyoming bringing it into the retail territories of the Standard Oil Companies of Nebraska and Indiana.

Another indication of the breaking up of old precedents was the purchase of the Beacon Oil Company by the Standard Oil Company of New Jersey. This transaction puts the New Jersey company in competition with the Standard of New York in New England and New York state.

Now we begin to get some idea why the problem of stabilization is more acute today than it was twenty years ago, or even a decade ago. Under former conditions the industry was dominated by a strong company controlling eighty per cent of the refined products whereas they now control approximately forty-five per cent. The Standard Oil Company has never had a monopoly on the production of oil because of its hazardous nature but when it controlled about eighty per cent of the refinery and marketing operations it had more influence on the control of production through fixing prices of crude than it has today. The presence of many large competing companies, even in the Standard group itself, and with the force of

14. Federal Trade Commission, *op. cit.*, pp. xvii-xix.

the law encouraging competition, there is less control over production than formerly.

Major Divisions of the Industry

The oil industry is divided into four major divisions: production, transportation, refining, and marketing. A complete company is one that performs all four functions. Most of the larger companies are complete in this sense. There are numerous companies that carry out only one of these activities. They are found mostly, however, in the production and marketing divisions. So much capital is required in the transportation and refining business that only a few companies compared to the number in the other divisions are engaged in these. Most of the oil is produced, transported, refined, and marketed by complete organizations. A large number of subsidiary companies are engaged in only one branch of the industry. They are usually considered a part of the complete organization when they are generally known to be subsidiary.

Pipelines

Pipelines, being public utilities, have separate corporate entities. However, their stock may be owned or controlled by companies engaged in other branches of the industry. It may be well to go into some detail because of the peculiar nature of the pipelines and explain their present status.

The history of the attitude of the government toward pipelines is somewhat similar to its attitude toward railroads. The first railroads built were operated on a purely competitive basis. So many abuses arose between the competing roads and with frequent discriminations toward the public in various ways especially in regard to rate making that the government had to take some step toward railroad regulation. The same may be said of pipelines. The right of eminent domain, the large amounts of capital necessary to build the lines, the interstate character of its business, the useless waste attendant to building competing lines, all these, give the pipeline business a monopolistic character. Only those companies with large sums of money to command could afford to build and operate pipelines and it was these big organizations that benefited most from these enterprises. The independent producer in the west and the small refiner in the east were at their mercy.

The Hepburn act was passed in 1906, declaring all pipelines transporting oil from a point in one state to a point in another were engaged in interstate commerce and were subject to the jurisdiction of the interstate commerce commission. This law seemed to have little effect on this phase of the industry and the position of the small independent producer was not improved. The problem of transportation was not a problem of the small producer against the large. Financially strong companies were able to build their own lines and it is reasonable to suppose that they did so to promote their own

interests. After the Hepburn act was passed they continued to do business the same old way and evaded the law because there was little effort to enforce it. The small producer felt hopeless and largely accepted the situation as it was. For this condition the interstate commerce commission was more to blame than the pipeline companies.

The Supreme Court of the United States declared the Hepburn act constitutional in 1914 and thus removed all doubts about the pipeline companies not being common carriers. In order to conform to the law more conveniently the pipeline divisions of the oil companies were incorporated as separate companies but the management and ownership remained practically the same. The Texas Pipeline Company is owned and controlled by the Texas Company, the Prairie Pipeline Company by the Prairie Oil and Gas Company, and so on.

The Federal Trade Commission in its letter on gasoline prices in 1924 to the president of the United States said:

> that although Standard pipelines have acted as common carriers only to a very limited extent for independent companies, all of the Standard refineries have constantly had common use of them, although many of the Standard refining companies have never owned pipelines either directly or through subsidiaries.[15]

These divisions of the industry are so closely related that anything that affects one branch affects the others also. The problem of overproduction is a problem that concerns the whole industry. Any improvements in refining whereby more gasoline can be obtained from a barrel of crude than formerly decreases the demand for crude oil, thus accentuating the problem of overproduction. New marketing devices stimulating the consumption of refined products create a demand felt throughout the entire chain of production. The problem of stabilization, therefore, is a community problem of the industry, not only for the highly integrated companies but for those business units engaged in only one or two of the branches.

Importance of the Industry

There is invested in the petroleum industry in the United States, according to estimates made by *The Oil and Gas Journal,* $11,300,000,000. This sum is divided among the four branches as follows: Production, $5,000,000,000; transportation, $1,800,000,000; marketing, $1,500,000,000; refining, $3,000,000,000. In the transportation division $900,000,000 are invested in pipelines, $300,000,000 in tankcars, and $600,000,000 in tanksteamers.[16]

The petroleum industry ranks among the foremost industries in the United States. Petroleum refining ranked seventh in value of products in

15. Federal Trade Commission, Letter of Submittal and Summary of Report on Gasoline Prices in 1924 to the President of the United States, mimeograph, June 4, 1924, p. 10.
16. "The Oil Industry's Answer Today," *The Oil and Gas Journal,* reprinted from December, 1927, issue.

1919, in 1921 it ranked second, in 1925 it ranked third, and in 1927 it fell to the fifth place in value of goods produced. According to the index of production of minerals compiled by the department of commerce the production of crude petroleum has increased more rapidly since 1919 than the production of all minerals combined or at a greater rate than the production of any other mineral. Likewise in manufacturing the production of refined products since 1919 has increased at a more rapid rate than that of all manufacturers combined or that of any single industry.[17]

Notwithstanding the fact that the petroleum industry provides itself with its own transportation system for its raw material it is one of the most important customers of the American railroads. In 1928 the oil industry was exceeded by only two others in the amount of revenue paid the carriers for the movement of carload freight. It was seventh in tonnage moved. The petroleum companies paid 8.56 per cent of the $4,317,698,000 which the railroads received for the movement of carload freight last year. [18]

These data presented in the preceding paragraphs reveal the importance of the petroleum industry in the economic life of today. The problem of stabilization therefore is rendered more acute because of its importance. Specialization of labor and capital is increasing more and more every year. With the growth of specialization there is a corresponding growth in interdependence of industries. What affects one industry is bound to be reflected in others. Hence the problem of stabilization does not concern the petroleum industry alone, for it is of great importance to all industries and in turn affects the interests of the entire population.

It may be pertinent to inquire here, who is the oil industry? It is roughly estimated that there are approximately 1,325,000 people, including officials, employed in all branches. There are approximately 7,000 separate companies, partnerships, and individuals producing oil and reporting production runs to the United States bureau of mines. Contrasted to conditions prevailing at the time of the dissolution of the Standard Oil Company in 1911, when few men were in control, the industry is disintegrated today as far as ownership of common stocks is concerned. The federal trade commission in its investigation of the extent of holdings of common stock in all branches of the industry reports 2,827 persons held as much an one per cent or more of the stock of their respective companies. Of this number only 163 held one per cent or more of the voting stock of each of two or more companies, and 511 held stock in each of two or more companies but had not more than one holding each of as much as one per cent. [19]

17. American Petroleum Institute, *Petroleum—Facts and Figures,* New York, 1929.
18. Interstate Commerce Commission Statistics of Railways, United States, 1928.
19. Federal Trade Commission, *op. cit.,* p. 79.

In its letter of submittal and summary of report on gasoline prices in 1924 the federal trade commission said that John D. Rockefeller, sr., was not reported by any of the twenty-four Standard companies as a holder of one per cent or more of its stock. John D. Rockefeller, jr. was the largest individual stockholder, having twenty-five per cent of the stock in the Atlantic Refining Company, nearly twenty-five per cent in the Standard Oil Company of New York, about twenty-four per cent in the Vacuum Oil Company, twenty-two per cent in the Standard Oil Company of California, thirteen per cent in the Ohio Oil Company, about eleven per cent in the Standard Oil Company of New Jersey, and about eleven per cent in the Prairie Oil and Gas Company.

John D. Rockefeller, jr., the Rockefeller foundation, and the general education board, a Rockefeller institution, are the only stockholders reported as owning five per cent or more of the stock of any of the twenty-four Standard Companies. These three stockholders combined own from 17.5 to about twenty-six per cent of the stock of eleven different Standard Oil companies.

In this same letter the Standard Oil Company of Indiana is reported to have had on December 31, 1923, 45,000 stockholders with ten holding twenty-four per cent of the stock, the Standard Oil Company of New Jersey nearly 26,000 stockholders with eight holding eighty-two per cent, and the Standard Oil Company of California had over 18,000 stockholders with five holding one-third of the total. [20]

The Texas Company, one of the large independents, is reported to have 30,000 stockholders in forty-seven states, the District of Columbia, Alaska, Hawaii, Philippine Islands, Porto Rico, Canal Zone, and a few stockholders living in foreign countries. [21]

During the period of domination and control by the Standard Oil Company the industry was in the "kerosene age." Until 1911 kerosene was the principle product of the industry. Coincidentally the "gasoline age" began about the time the Standard Oil Company was dissolved by order of the United States supreme court. If the supreme court had not interfered with the centralization of the industry under the leadership of the Standard Oil Company it is reasonable to assert that decentralization would have taken place anyway. The motor industry would have decentralized it. Through the enormous expansion of the motor industry during the last two decades the demand for motor fuel has arisen correspondingly. To have met this growing demand the Standard Oil Company would have had to increase its capital several times its size in 1911. The investment in the industry today is estimated at $11,300,000,000. Allowing for considerable duplication the

20. Federal Trade Commission, Letter of Submittal, etc., pp. 10-11.
21. *The Oil and Gas Journal*, March 11, 1926, p. 145.

Standard Oil Company would have had to increase its capital to $7,000,000,000. There is no $7,000,000,000 company today. In fact, it is doubtful if a company that size could be managed efficiently. During the process of expansion independent organizations would have increased in power. While it is difficult to say exactly what would have happened had the supreme court decided the other way, no doubt competition in the market, and especially competition in production (always individualistic), would have come about and with it a problem of stabilization.

Petroleum is produced in nineteen states and refining is carried on in twenty-nine. More states in the Union have a significant share in the petroleum industry than there are cotton states, or wheat states, or corn states, or steel states, or textile states. According to the federal oil conservation board there are in excess of 3,000,000 acres of proven oil area.[22] The federal trade commission estimates there are over 22,000,000 acres of unproven oil lands.[23] Much of this land is already under lease by the oil companies. There are no figures available to show the number of land owners, farmers, lease brokers, royalty operators, investors, and others who take part in the business.

The petroleum industry is the most American of all American industries. The modern industry originated in America, financed primarily by American capital, and developed to the present high state through American inventiveness and genius. Seventy-five per cent of the invested capital in the world industry is American and fifteen per cent British.[24] The problem of stabilization of the petroleum industry is, therefore, an American problem.

Unusual Character of the Industry

The petroleum industry has four characteristics that distinguish it from most other industries.

The first three of these characteristics involve directly the problem of stabilization. First, the industry has no control over raw material. Second, the source is unknown. Third, the supply is uncertain. Fourth, the industry has its own transportation system for raw materials.

The industry has no control over raw material because there is no way of estimating accurately the extent of its supply. This point will be treated more in detail in the next chapter. Agriculture can regulate supply to some extent by restricting, or increasing, acreage. The crop reporting service acting with the weather bureau can to a fair degree estimate in advance the extent of farm production. The production of coal, iron, and other solid minerals can

22. Report of the Federal Oil Conservation Board, Part 1, September, 1926, p. 8.
23. Federal Trade Commission, *Report on the Petroleum Industry, Prices, Profits and Competition*, December 12, 1927, p. 21.
24. *The Oil and Gas Journal*, May 14, 1925, p. 68.

be regulated because the extent of their resources can be gauged fairly well. Trees can be cut or left standing in the forest. Through reforestation the supply can be replenished. In all economic activities, primary or secondary, man has more control over the amount of raw material than in the petroleum industry.

In the next chapter it will be shown how geology has contributed to the reduction of risk in the production of oil. Through geology the industry is permitted to know where petroleum is more likely to be found but the only sure way to find oil is to drill for it. Until the well is drilled the operator is unable to determine whether it will be dry, a small producer, or a big one. There are plausible theories concerning the source of petroleum but no one knows definitely how petroleum came to be.

The supply is uncertain. Fields have been found full of promise. They produced for awhile and later were abandoned for want of production. Areas have been condemned and later explorers more intrepid than the rest sent the drill deeper to bring in some of the world's greatest pools. Fields that have given promise of abundant production have been ruined with salt water. No one is certain of the supply of petroleum. Like the player at roulette who places his chips on many numbers and colors to reduce the risk, many operators scatter their interests over many districts trusting that some of them may prove successful.

There is no industry in the world that has a transportation system all its own that is so extensive. Water is distributed through pipelines, but the oil industry carries its product thousands of miles through pipe. Pipelines extend from Wyoming to the Atlantic coast, and from the lakes to the Gulf. Its method of transportation is so important, as described above, that the federal government has put all interstate pipelines under control of the interstate commerce commission. Intrastate lines are under similar control by their respective state commissions. The total pipeline mileage is slightly more than 90,000 miles with a capacity of 15,750,000 barrels which is nearly one-fourth of the nation's average production for one month. These lines vary in diameter from two to sixteen inches, the weighted average being six inches. There are more pipelines in Oklahoma than in any other state. The total for Oklahoma is 19,180 miles. Texas ranks second and Pennsylvania third. California is the greatest oil producing state in the Union. The fields are near the coast. The oil is carried through comparatively short lines to the coast where it is transferred to tanksteamers and then to refineries on the Atlantic seaboard and in foreign countries.[25]

25. G. R. Hopkins and A. B. Coons, *Survey of Petroleum Pipelines and Storage Capacity for Crude Oil and Refined Products,* Bureau of Mines Circular No. 6016, January, 1927.

The development of transportation of petroleum by water has had considerable influence on the economic development of the industry in the United States. Through the use of the tankship immense quantities of oil are brought into the United States from South American countries and Mexico which in turn has an influence on the market for crude oil from fields in the interior of the United States. For this reason it is appropriate at this place to give some consideration to water transportation.

The transportation of petroleum by water is carried on mostly between sea coast refineries of the United States and California, Mexico, and South America. Of course, with the possible exception of shipments to Canada, and Mexico all our export business is carried by water. There is considerable transportation of petroleum by barges on the rivers, lakes, and canals in the United States. The tanksteamer, commonly known as the tanker, and the Panama Canal are responsible for the rapid development of the California fields. If it were not for these, California oil would not play such a powerful influence on the world's markets and the only outlet would be the Pacific coast and the Orient.

The first petroleum carried by water was crude oil down the streams in Pennsylvania to the nearest centers of civilization. The first oil sent abroad was refined oil. It was illuminating oil shipped from Philadelphia to London in 1860. This oil was shipped in wooden barrels and was only a part of the regular cargo.

This attempt was an experiment and it proved successful. In 1861 the first exclusive overseas cargo of petroleum products sailed for London in the *Elizabeth Watts*. This cargo contained approximately nine hundred barrels. It took much more time to load and unload this cargo than the ordinary cargoes of that day. So much hazard attended the transportation of petroleum products by this rude and simple method that it is said sober crews could not be obtained. However, the *Elizabeth Watts* arrived at the docks in London in good shape, and the cargo was in better condition than the crew. The success of this trip encouraged others and a brisk foreign trade in petroleum products was begun. This resulted in the demand for wooden barrels to exceed the supply and the price for these containers soared beyond reasonable figures. The costs of shipping these products also increased because of the length of time it took to load and unload. Barrels were eventually discarded as containers because so much space was wasted between them. In order to conserve space cases were used. They were unsatisfactory because they leaked, not only causing a loss of oil but increasing fire hazard.

The next step in the development of marine transportation came in 1869 when a vessel was fitted out with fifty large iron tanks built in the hull of the ship. These tanks leaked too, the oil and gas escaping from them lodged

between the tanks and the sides of the ship which made transportation doubly dangerous.

The development of the modern oil tanker is described very concisely in a paper read by J. C. Rohlfs, manager of the marine department of the Standard Oil Company, California, at the fourth annual meeting of the American Petroleum Institute in St. Louis in 1923.[26] The following is an extract from his paper:

The next development was to build in the hull of the ship a series of tanks, by dividing the entire buoyant hull space into tanks through the use of crosswise and longitudinal bulk heads, the skin of the ships forming the outside of the tanks—and bulk oil for the first time was loaded to the skin of the ship. The division of the vessel in this manner practically achieved oil tightness, resulting in such perfect construction that various grades of oil may be carried in adjacent tanks without danger of contamination. Some tankers are fitted for the carriage of general cargo, means being provided for the sweetening and cleaning of the oil-tanks, thus permitting the carriage of bulk oil cargo one way and general freight on the return voyage. Bulk liquid return cargoes sometimes were offered, consisting of coconut oil, creosote or molasses.

To the Riedemonn's of the German-American Petroleum Company, Hamberg, must be given the credit for conceiving the idea of carrying oil in bulk to the skin of the ship. No shipyard in their own country would take up the "crazy" idea, and only one English firm, that of Messrs. Armstrong, Mitchell and Company would consider it. The firm finally fell in with Riedemonn's plan, so that in 1885 the first what may be considered modern oil tanksteamer, was built. Its name was *Glückouf.* This steamer which was three hundred feet long and carried possibly 25,000 barrels of bulk oil, discharged its first cargo at Goestemunde in July, 1886. The *Glückouf* was a success.

History records that Russia immediately followed in the steps of the German oil company, and shortly after the introduction of the *Glückouf* the Russian tank-steamer *Sviet* made its appearance. This vessel was built at Gothenburg for the Russian Steam Navigation and Trading Company of Odessa. The *Sviet* exported Russian oil in bulk.

In 1886 there were only about twelve bulk oil-carrying vessels. In 1891 between seventy and eighty were running from America to Baku, to European oil importing ports. This really constituted the first oil tanker boom, sixty to sixty-five vessels built in five years.

The first American tank-steamer was fostered by the Standard Oil Company and was built in 1888 by John Roach, Chester, Pennsylvania. It was the *Standard,* with a capacity of four thousand barrels. In 1895 or 1896 an explosion of the vessel in Philadelphia set it afire. The hull was saved, the engine and boilers removed and what remained is now a tow barge, and still in service. The first ocean going Pacific tanker, the *George Loomis,* was built by the Union Iron Works in 1896 for the Pacific Coast Oil Company and afterwards purchased by the Standard Oil Company. This vessel had a capacity of 6,500 barrels, underwent one rebuilding and finally was lost at sea with all hands in a terrific storm.

It is interesting here to note that the *George Loomis* required four or five days to load and about the same number of days to discharge, the loading and discharging being accomplished through two inch lines. Up to the late war, Europe must be given credit for the development of the large capacity ocean tanker, the reason no doubt being that the American oil export companies could not build and operate American tankers in competition with

26. J. C. Rohlfs, "Oil Marine Transportation," Report of the Fourth Annual Meeting of the American Petroleum Institute, St. Louis, December, 1923, p. 47.

foreign built and owned tankers. The size of the American tanker up to this time was governed entirely by the demands of the American coastwise trade, due to government protection no foreign vessel could enter this trade.

That coastwise trade also developed the towing steam oil tanker and barges, the object being to drop the barges at ports on voyages north or south from manufacturing centers, picking them up on the return voyage for re-loading. Towing was developed to such an extent that one Pacific Coast Steamer, *Richmond,* and *Barge, No. 95,* made a tow voyage around the world. The Anglo-American Oil Company, Limited, of London tried further development along this line by building the tank barge *Navahoe* and the steamer *Iroquois* some years prior to the war, the combined cargoes aggregating 115,000 to 130,000 barrels.

Since the World War American oil companies have devoted increased attention to marine shipping. While much of the foreign tonnage is American owned because of tariff laws, foreign shipping laws, and general reduction of operating expenses, this competition is being met by ships under the American flag by increased use of machinery, thus lowering operating costs, and by more scientific management.

A survey of the tanker ships engaged in, or available for, handling the world trade in petroleum and other oils and liquids, made by the bureau of research, United States shipping board, indicates that on July 1, 1925, the United States ranked first in ownership of this class of vessels, with forty-five per cent of the gross tonnage and thirty-nine per cent of the total ships. Great Britain was second with thirty-five per cent of the gross tonnage and thirty-eight per cent of the ships.

The largest individual owner of tanker ships sailing under the American flag is the Standard Oil Company of New Jersey. According to the annual report of the company for 1927 to its stockholders there were ninety-six tankers aggregating in excess of 1,000,000 deadweight tons owned by its subsidiaries at the close of the year. Of this total thirty-eight tankers of 480,000 tons were operating under the American flag; fifty-four, totalling nearly 479,000 tons were operated under foreign flags and four Diesel ships of over 68,000 tons were under construction. [27]

There is evidently no fear of oil tariff legislation which would restrict the import of crude into the United States, judging by the tanker building program of the exporting companies. It is not to the advantage of any company to own enough tonnage to carry its maximum business, because when business falls off it will have a surplus lying idle that will be additional expense. It is best to own sufficient for ordinary uses and lease the rest as the occasion demands.

The oil tanker has many economic advantages over the pipeline, because it is cheaper. When business is dull the tanker can be converted to other uses. It enables the refiner and marketer to reach easier both a source of sup-

27. *The Lamp,* June, 1928, p. 24.

ply and market. The oil tanker permits the refiner to locate refineries better in regard to existing and potential markets. The oil tanker has made possible an easy access to Californian, Mexican and South American crudes much to the inconvenience of the Mid-Continent producer.

The oil industry has been characterized as an extremely hazardous industry because of its uncertainty of supply. For this reason a substantial portion of the general public, in spite of its gullibility still regards the oil industry as largely speculative. It cannot be denied that there is a large element of risk, but this much must be said in its behalf that it has risen to every demand that has been placed upon it. The problem of supply will be discussed in a later chapter. The public may sometimes hesitate to invest in the industry on occasions, however, it has never hesitated to use its products.

The use of petroleum is very important in the economic life of today. In 1929, according to the United States bureau of mines forty-four per cent of the refined products went into gasoline. Fuel oil and gas oil is the next most important product. Industrial life is more dependent upon lubricating oil, although it ranks less in point of volume than any other because substitutes can be made at some price for gasoline. Lubricating oil has no adequate substitute. Oil is used in the making of highways, in the tires that wear out the highways, in lubricating and propelling the vehicles that travel over their surface. Subsurface sea crafts would be impossible without oil. Aviation would be impossible without petroleum. Asphalt from oil is used in making airplane run-ways and without a high grade gasoline the airplane would never be able to leave them. The use of petroleum has found its way into practically every department of human activity, work and play, toil and leisure.

CHAPTER THREE

NATURE AND ORIGIN OF CRUDE OIL

IF all crude oil were uniform in character and if its origin were known the problem of stabilization would not be so complicated. Chemically speaking, oil is both simple and complex. It is simple because it consists of two very common elements, hydrogen and carbon. It is complex because these two elements are united with each other in so many various ways that they form numerous solid, liquid, and gaseous compounds.

Petroleum appears in many colors and with various odors as it comes from the wells in the various fields throughout the world. It takes the name "liquid gold" from its yellow hue and yield of dollars. It appears in other places in green with the colors of the rainbow glistening in it. Again, it is black as ebony. Some oil flows almost as freely as water. Other oil is very viscous and must be heated in order to be carried through the pipes.

Although no two crude oils are exactly alike it is customary to classify them according to their base. This classification falls into three groups: paraffin, asphalt, and mixed base crudes. Usually the paraffin base oils have a higher gasoline content, and also are valuable for kerosene, light lubricating oils, cylinder oils and waxes. Mixed base oils produce the same products as the paraffin base oils except the gasoline content is not so high, and fuel oil is an added product because there is a residue left in the refining process. The asphalt base oils are especially adapted for fuel oil, lubricating oil, and asphalt.

These factors are of considerable importance in influencing the marketability of petroleum. Oil rarely is found as a pure hydro-carbon. It often contains impurities, chiefly oxygen, sulphur, and nitrogen compounds. Sulphur is most objectionable because of its corrosive influences. Ordinarily the higher gravity oils with a greater gasoline content command the highest prices in the market. If the petroleum is to be transported by pipeline from the well to refinery, the pipeline companies insist that the oil contain less than one per cent of water and "bottom settlings."

The second method of classifying crude oils is according to geographical groups. Oil in each major group is more or less alike and differs from typical oils in other groups. The bureau of mines classifies them into the following: Eastern, Mid-Continent, Gulf coast, Rocky mountain, and California.[1]

1. Bureau of Mines, *Manufacture and Characteristics of Gasoline,* Information circular No. 6006.

The eastern field includes the wells of Pennsylvania, West Virginia, New York, Ohio, Kentucky, Indiana, Illinois, and Michigan. The crudes of Pennsylvania, West Virginia, New York and eastern Ohio are more similar and are considered as a unit. The crudes of Kentucky, Indiana, Illinois, western Ohio, and Michigan are not so homogeneous yet they have this in common, in comparison to the group above, they yield less gasoline by ordinary methods of distillation. They also require more chemical treatment for the production of lubricating oils. A large quantity of road oils and fuel oils are produced from them.

The first group contains a comparatively large proportion of gasoline under ordinary methods of distillation. Lubricating oils are produced by the use of a comparatively small amount of chemical treatment. Steam cylinder stocks are made with little or no chemical treatment. All the oil in the entire eastern group may be classified generally as having a paraffin base.

The Mid-Continent area includes Oklahoma, Kansas, Arkansas, northern Louisiana, north and west Texas fields. There is considerable variation in grade in the oils from this area. They have all three types of bases. The proportion of gasoline obtainable by ordinary methods of distillation varies more than in the eastern group. The lubricating oils produced from them require more chemical treatment. There is a large amount of steam cylinder stock produced from them. Considerable paraffin wax and asphalt are produced according to the respective type of oil. Road oils are a common product. The asphalt is used primarily for paving and the manufacture of roofing materials.

The crude oils of the Gulf coast region are peculiar. There are some crudes in this field which contain gasoline and paraffin wax and again some contain gasoline and no wax and there are still other crudes that contain neither gasoline nor wax. The principle refined product from the crude of this region is low-cold test lubricating oil.

Although practically every product of petroleum is made in the complete refineries of this district, many of their products are made from crude from other fields. As a rule, the base of the oil produced in this region is asphalt.

The Salt creek, Wyoming, field furnishes most of the production from the Rocky mountain region. The crude oil from this district contains about twenty-five to thirty per cent gasoline. Some of the smaller fields are similar to the Salt creek field; a few are radically different. The crudes from these small fields vary in gasoline content from less than ten per cent to more than fifty per cent. Practically all the crudes from this region have a paraffin base. In character these oils are intermediate in properties between the oils of the eastern region and those of California.

The fields in California are divided into three broad classifications: the north coast, the south coast, and the San Joaquin valley fields. A large per cent of the oil produced in California, like the Gulf coast oil, has an asphalt base. However, the oil from the south coast region, the Santa Fe Springs field for example, has a high gasoline content as well as paraffin wax. It has only been within the last few years that the production of this type of oil in California has reached considerable proportions.

Crude oils from Mexico and South America have furnished for some time a considerable source of supply for refineries in the United States. These oils like the oil in the United States vary in content. Some of them are like the Mid-Continent crude. A large proportion of them are like the Gulf coast and California oils in that asphalt is the base.[2]

For purposes of comparison and to show the variety of properties in the crude oil from some of the representative fields in the United States, selected at random, Table II is presented.

The deepest producing oil well in the world is in Reagan county, Texas. The depth of this well is 8,525 feet. The deepest nonproducing well in the world is in California. It exceeds 9,200 feet. A peculiar feature of the Texas deep well is that it produces an oil of unusually high gravity, so high in fact the purchasing companies will not take it at its true value. It is mixed with lower gravity crudes of that region to bring them up to the highest acceptable grade. Another peculiar feature of this well is that its production increases each year instead of decreasing as is customary with most wells. The oil is seventy per cent gasoline and in fact can be used in cars unrefined.

Gravity, The Basis of Price

Gravity is the basis on which crude oil is bought, higher gravity oils bringing the higher prices. It is very difficult to purchase oil on a strictly chemical analysis basis because oil can not be segregated in the pipelines leading from the fields. Oftentimes, however, refining companies offer a premium for oil with a higher gasoline content although the oil may have no higher gravity than other crude with a lower gasoline content. The oil listed in the price tables of the petroleum trade journals is classified according to fields and prices are posted according to gravity in the respective field. The method by which these prices are determined will be discussed in a subsequent chapter.

The system of basing prices upon the gravity of crude oil is very inadequate. Gravity, though easy to determine, means very little. It is better than the old flat rate schedule previously used but at that it is a poor device. The most up-to-date refiners have well equipped laboratories for the analysis

2. *Op. cit.*

TABLE II
Analyses of Some Representative Crude Oils in the United States.*

States / *County*		*Oklahoma Osage*	*Oklahoma Creek*	*Oklahoma Wagoner*	*Oklahoma Carter*	*Pennsylvania McKean*	*Texas Eastland*	*Texas Harris*	*Wyoming Natrona*		*California Fresno*	*California Barbara*	*California Los Angeles*
Properties of Crude	Sp. Cr.	.837	0.828	0.864	0.870	0.823	0.840	0.948	0.841				
	Baumé	37.3	39.1	32.0	30.9	40.1	36.7	17.8	36.5	(4)	29.3	23.0	31.7
	% Sulphur	.32	0.28	.15	.72	.10	.17	2.40	.18		.67	2.63	0.54
(1) Viscosity of 70° F		49.6	47.2	154	95.8	46.6	47.4	1100	95				
Viscosity of 100° F		43.0	37.0	68.2	64.2	40.8	40.0	358.	50.2		56.	25.2	51.
(2) Pour test °F		10	Below 5	Below 5	Below 5	Below 5	Below 5	Below 5	57.		10	Below 5	35
Gasoline %		29.7	37.5	16.9	22.3	32.5	30.2	3.7	29.3		19.8	21.8	27.9
Fraction Sp. Gr.		.746	.743	.765	.753	.739	.759	.823	.750				
Baumé		57.7	58.4	53.0	55.9	59.4	54.5	40.4	58.7		51.1	52.7	52.5

1. Sayboltt Universal.
2. A. S. T. M. Standard Method.
3. Sample 458, San Joaquin Valley; 1163, north coast; 1139, south coast.
4. A. P. I. Test for California grades.

*Adapted from data from the bureau of mines.

of crude oil. There are other refiners, small and large, that buy their raw products without preliminary inspection and analysis, and on prices based upon gravity as an indication of quality and gasoline content. These refiners are risking great losses, which risk can be eliminated by crude analysis prior to purchase.

Conservation implies greater utilization. The refiner can contribute to the stabilization of the industry by improving his technology. This applies to economic as well as engineering, technology. According to figures of the bureau of mines, 130,128,000 barrels of gasoline were produced during the first eleven months of 1929 by the process of cracking fuel and gas oils. The use of engineering technology has advanced further than economic technology. If all crude oils were analyzed prior to purchase and the purchase based on the most economical use obtainable from the particular crude, and if the runs to stills were kept in line with the current rate of consumption, then a large part of the burden would be lifted from the shoulders of the producers in their efforts to stabilize the industry.

According to W. C. Mendenhall, chief geologist of the United States geological survey, geologists have come to realize they know nothing of the natural laws governing the generation and storage of oil.[3] The ignorance of this fundamental fact has for a long time created within the industry a fear that within the near future the world's oil resources would be exhausted. If the principles governing the generation and storage of oil were known it might serve to allay these fears and, yet, this knowledge could greatly aggravate them. However, the knowledge would serve the useful purpose of reducing an uncertainty to a certainty. The fact that man knows little about the origin of oil and how it came to be where it is, has been no small contributing factor to the lack of stabilization within the industry.

The Origin of Petroleum

There are three theories concerning the origin of petroleum: The cosmic theory, the inorganic theory, and the organic theory.

According to the cosmic theory petroleum was made at the same time as the world by the Creator. It was in the form it is now and little or no change has taken place from that day to this. This theory has no scientific justification today.

The inorganic theory states that petroleum was formed in the earth through chemical action that has taken place in the subterranean recesses through the ages past. This theory has been disproved because deep drilling has demonstrated that surface waters do not penetrate as deeply through the earth's crust as was supposed formerly. It was thought the surface water

3. *The Oil and Gas Journal*, January 7, 1926, p. 98.

penetrated the earth's crust coming in contact with carbides, thus forming a series of hydrocarbons. Extensive explorations beneath the surface during recent years have not given encouragement to this theory. The theory of the generation of hydrocarbons from metallic acids can be demonstrated successfully in the laboratory, but it is so incompatible with the geological occurrences of oil observed in the field as to command little consideration.

Most geologists today agree that petroleum and natural gas were formed by the slow decay of small marine plant and animal remains that were buried in the sediments of the sea. The fact that the oil fields are found in former marine basins, while the great volcanic regions of the earth where the inorganic processes are more likely to take place yield no oil, is advanced as argument in support of this theory.

Both theories agree than oil has migrated from its point of origin to places where it is found now. Since oil is lighter than water with which the rock formations are saturated the oil and gas have a tendency to migrate upward, working their way to porus beds and following freely their course until stopped by impervious rock. An oil pool, therefore, is thought to have a convex shape lying under strata of impenetrable rock. Normally, the order of occurrence is gas just below the cap-rock, then oil, then water. It is the work of the geological staff to locate the anticlinal structures, for it is in the anticline or convex structure that oil is found. The presence of a syncline condemns the land as far as the prospects for oil are concerned.

Most geologists believe that oil is produced by geological forces acting through a long period of time on the remains of aquatic organisms buried in the sediments of the sea. While the evidence is circumstantial, yet it is convincing, that petroleum is a geochemical result of rock pressure and earth temperatures working through long intervals of time, and possibly under catalyzing influences, on fossil organic matter. These small organisms, dying and settling to the bottom of the sea, buried by mud which has become the shales, limestones and sandstones of today, sealed from the air, and further protected from ordinary decay by the brine of the ocean itself, were subjected to a slow process of decomposition. Ultimately they yielded, among other products, petroleum as we find it today.

Here, however, is the question as to the primary contribution or the generation of oil through the biochemical decomposition processes at the time of deposition of the organic debris in the sediments, on the one hand, as opposed on the other, to the generation of the oil at different times long afterwards by what might be termed natural geological distillation in the crust of the earth. The latter view implies the restriction of oil fields to areas subjected to compressive stresses.

It has generally been assumed that it is decay of organic remains, possibly assisted by bacterial activity, which makes petroleum. The recent contribution of our knowledge on this subject through the American Petroleum Institute research projects is of particular interest, therefore, because it proves that oil is actually generated by some forms of life before death intervenes. This would make oil a direct product of vital processes of living creatures rather than a result of the slow decay and slow distillation of dead organic matter.

Professor C. F. Tolman, of Stanford university, who with several associates, carried out the research project in question, took up the study of living diatoms in the hope that from their life history he might learn something which would bear on the suspected relation of the great deposits of fossil diatoms to the oil in the California fields. He found that at places along the beaches of the Pacific coast "diatom epidemics" take place, during which thousands of tons of diatoms are washed up by the surf, and that this diatom debris contains a large proportion of oil. He and his associates collected and analyzed the samples of this oil and found it to consist of hydro-carbons and sulphur. California oil, like other crude oil, is essentially a mixture of hydro-carbons, but remarkably enough in this connection, it is distinguished generally by a high sulphur content. Moreover, these investigators were able actually to observe the direct manufacture of this oil by living diatoms. Under the stimulus of sunlight the plant is able to break up carbon dioxide and water to form hydro-carbons.

Probably this oil would eventually be consumed by the organism under normal conditions, but in the case of great epidemics, such as those under observation, the oil along with other remains of the diatom, becomes a part of the sea bottom ooze. These epidemics occur, apparently, in connection with an unusual influx of fresh water into the ocean, due to flood conditions on land. In fresh water the shell of the marine diatom breaks up and the oil which it contains escapes into the surrounding jelly-like medium, where it is absorbed and held.

Curiously enough the fossil diatom beds of the California oil fields manifest most evidence of oil where the diatom remains are not well preserved, and the beds which are composed entirely of diatom skeletons and shells intact and unbroken often show little or no oil. This apparent anomaly, which has always puzzled previous investigators who have sought to connect diatoms with the source materials of California oil, now takes on a new and important significance in the light of Professor Tolman's work. It is just what might be expected from his findings that vast quantities of diatoms perish prematurely when fresh water floods their abode, and that in such occurrences their shells are broken to fragments and the store of oil which they have manufactured is absorbed by the debris of their remains and carried down to the bottom. On the other hand, under normal conditions the diatom lives, consumes the oil in vital processes, and finally dies, so that his empty shell falls to the bottom intact, to become a part of pure diatom beds, barren of oil.[4]

The development of the science of geology has done much to reduce the risk and uncertainty in discovering and bringing to the surface the raw material. It is still true today as much as it was a few years ago when the science was not so well developed that the only sure way to find oil is to drill for it. This fact has given to the industry a large element of risk that is more pronounced than in any other basic industry.

An example how geology has eliminated risk is given in Table III. This table gives the oil areas in the United States with the number of fields in

4. Wallace E. Pratt, geologist of the Humble Oil and Refining Company, "Oil in the Making," *The Lamp,* 1927, p. 9.

each district in 1926 and the number and percentage of the fields that have been located according to geology. Since this date, it is safe to say, the percentage located by geology would be considerably higher. Of the one hundred and nine fields listed geologists are responsible for eighty, or 73.4 per cent of the fields discovered.

TABLE III

The Percentage of Oil Fields in Existence in 1926 Located According to Geology.[5]

District	*No. of Fields*	*Geology Number*	*Geology Per Cent*
Oklahoma-Kansas	31	21	67.7
Texas (outside Gulf Coast)	25	11	44
Texas (Gulf Coast)	19	19	100
North Louisiana and Arkansas	11	6	60
Rocky Mountain	15	15	100
California	8	8	100
TOTAL	109	80	73.4

5. Dorsey Hager, "What the Geologist Has Done to Open Producing Fields," *The Oil and Gas Journal,* April 8, 1926, p. 158.

CHAPTER FOUR

OIL AND GAS RIGHTS

THE institution of property rights, as it has affected the petroleum industry, is the most important factor in stabilization of the industry. This institution has its foundation on our common law which is English in origin. The common law as it is applied in the United States is the common appellation of the entire English law, including even the foreign elements intermingled with it, in distinction with the civil law generally received among European nations, and from the canon law, except so far as adopted in the ecclesiastical courts of England. It is Saxon in origin. But in so far as it relates to real estate it has been highly colored by Norman influence beginning with the Norman conquest.

According to the feudal law the rights of the individual were absorbed by the kings and barons. All property rights in the soil rested in the feudal lord. This included minerals and other properties of the soil that were considered valuable. Since all these rights belonged to the feudal lord he only could dispose of them as he saw fit. Through the process of time, in Europe, as the peasants gained control of the land and secured title to it, the title to the subsurface remained with the crown which, while the peasants had been struggling for the right to till their own soil, had taken these rights from the barons because they had lost their power through wars and political struggles. These changes did not take place simultaneously in all countries.

The development of the law in England followed a different course. As the land slipped from under the control of the feudal baron and its ownership became more widely distributed the right to the subsurface went along with the right to the surface. So we have the common law rule relating to land as stated by Blackstone:

> Land hath also, in its legal signification, an indefinite extent, upwards as well as downwards. *Cuius est solum, eius est usque ad coelum,* is the maximum of the law; upwards, therefore, no man may erect a building, or the like to overhang another's land; and downwards, whatever is in a direct line, between the surface of any land and the center of the earth, belongs to the owner of the surface; as in every day's experience in the mining countries. So the word land includes not only the surface of the earth but everything under it or over it. This theory is incorporated in the fundamental law of the land.[1]

During the colonial days the common law was transplanted in the thirteen original colonies along with other English customs. The love for things English was none too great when the colonies adopted their own body of law but the fact was that most of the jurists of the day could not read codes of

1. Blackstone, Book II.

the continental countries. The line of least resistance was to adopt the English common law which they could read and with which they were more familiar through experience.

At this time very little was known of petroleum, its origin, uses, and possibilities. In fact, very little concern, it seems, was given to mineral resources in the thirteen original colonies.

George Washington owned land across the mountains on which there were oil seepages but he valued this land lightly. The colonists gave little thought to the subsurface since their primary interests in the soil were in the products taken from the surface, in hunting, in fishing, in forestry, and in agriculture. Also, their industrial life was influenced largely by the sea. So naturally, in adopting the constitution, little thought was given, one way or the other, to subsurface rights and it was left to the fee owner, or land owner, to dispose of the subsurface and its products in any manner he saw fit.

In the colonies established in America and elsewhere by the continental countries all mineral rights were held by the crown from the beginning. The Spanish had a different motive in colonizing Central and South America than did the English in North America. Their primary purpose was to seek valuable minerals, particularly gold. It was to be expected, therefore, that these rights would be reserved by the crown. When the Latin American republics gained their independence it was logical that the respective countries should succeed to the ownership of the mineral rights. It has been only in recent years that any concerted effort has been made in these states to explore for oil. Impoverished through long and protracted revolutions, and often under the domination of dictators, they have granted large and generous concessions to develop to private and corporate individuals. More frequently than not, they granted the right to explore for oil and gas exclusively. The state reserved the other mineral rights. The existence of petroleum in the countries south of the Rio Grande has been known for a long time, but the development of the industry is comparatively recent.

Had the founders of the United States reserved the mineral resources for the government, whether their exploitation were to be by governmental or private enterprise, many of the problems that confront the petroleum industry and some of the other mineral industries, would not exist today. Overproduction has upset the oil business frequently since its beginning. Regulation of the production of petroleum could be achieved more easily were the government the owner of all subsurface rights. Of course, it is too late now even to suggest such a change, for the problems that would result from the consequent disruption of industrial organization would be far more serious than those that now confront the industry.

Because of unsettled conditions in the industry and of the many complicated problems resulting from them, much has been written in support of, and in criticism of, the present system. Proponents of the system are not infallible in their arguments. They cite statistics showing that the United States produce approximately three-fourths of the world's petroleum; they show that industrial progress is dependent on oil, since no wheel turns unless lubricated with petroleum, and conclude that the splendid industrial advancement made in America is the result of this policy. They also cite statistics to show that industry is not as far advanced and as well developed in the countries where the oil resources are large and controlled by the government. The logic of this argument is unsound. The data are not homogeneous. There is no common ground for comparison and cause and effect have been confused. The petroleum industry had its birth in the United States. This fact alone had something to do with the delay in the development in other countries. The climate, the character of the people, the economic and social environment of all countries concerned are forces that must be considered. However, the American system is not yet vindicated. Especially true is this statement if the resources are soon exhausted.

The advocates of the American system maintained that in those countries, such as Persia, Venezuela, (until recently), Colombia, Dutch East Indies, India, Trinidad, Egypt, and Peru, where concessions covering large acreage have been granted, the companies owning these concessions, after they have developed the properties to a commercial stage, increase production less proportionately than would be the increase under a more competitive system, because the land is held in large blocks by one or a few companies. They maintain that had development in the United States been influenced by the same conditions the growth of the petroleum industry and industries dependent on it, such as the automobile industry, would have been retarded.

It is not the petroleum business that has made the automobile industry prosperous, rather it is the automobile business that has given impetus to the petroleum business. The industry was on a kerosene basis until the gasoline engine revolutionized it. As long as the automobile industry demands it, large concessionaires as well as small operators will do their best to supply the demand. If the resources are developed on concessions obtained from the government the government can control the monopoly so that the dependent industries will not suffer. There is more economic gain under a system where production of oil is under efficient governmental control than under the highly competitive system. However, recent conduct on the part of the United States government in the administration of its oil properties has by no means strengthened the argument for government control.

Let it be repeated here that complications would set in presenting more

serious problems than are present now if an attempt were made to change the system under which oil and gas rights in the United States now are controlled. It is unfortunate that our forefathers, who exercised splendid judgment and forethought in regard to many things, were not permitted to get a glimpse of the possibilities of petroleum and act accordingly.

Legal Interpretation of Oil and Gas Rights

More than three-quarters of a century elapsed after the adoption of the constitution of the United States before the courts were called upon to establish definitely oil and gas rights. Since it was not until 1859 that the first well was drilled for oil for commercial purposes, the body of law relating specifically to oil and gas rights has been created since that date. When the first disputes arose concerning the rights to oil and gas the courts were compelled to seek for precedent decisions affecting other subsurface rights. The decisions dealing with subsurface water rights had important bearing on later decisions relating to oil and gas. The case of Acton vs. Blundell[2] is quoted frequently as an example. The court said:

> We think the case, for reasons given above, is not to be governed by the law which applies to rivers and flowing streams, but that it falls within that principle which gives to owner of the soil all that lies beneath the surface; that the land immediately below his property, whether it is solid rock, or porous ground, or part soil, part water; that the person who owns the surface may dig therein and apply all that is there found to his own purposes at his free will and pleasure; and that if, in the exercise of such right, he intercepts or drains off the water collected from under ground springs in his neighbor's well, this inconvenience to his neighbor falls within the description of *damnum absque injuria,* which cannot become the ground to an action.

The first recorded case dealing specifically with oil dates back to 1854, five years before Drake's well. Drake was the first man to drill for oil for commercial purposes. There were wells before this one in which oil seeped in. In those days the principle use for oil was for medicinal purposes. Where oil was found it was appropriated. The defendant in this case[3] had taken three barrels of oil from the plaintiff's well. The court held that the owner had exclusive property in the well.

Confusion arose in the beginning in the interpretation of the common law. Oil was declared a mineral and therefore belonged to the land so the ordinary surface lease on the land did not give power to extract the oil and gas. The power to convey substances is incident to ownership. But oil and gas migrate, so the question came up, can the owner lose them, like wild animals, without his consent.

The earlier decisions affecting oil and gas rights were based on the theory that oil and gas, like percolating water and wild animals were migra-

2. 29 *Yale Law Journal* 174 (1843 Exch) 12 M & W 324.
3. Hail vs. Reed (1854) 54 Ky. 383.

tory. Recent geology, however, has disproved this theory. It is the current opinion of geologists that oil and gas are impounded in pools and remain in a given locality unless released through drilling, an earthquake, or some other subterranean movement like a landslide, which rarely occurs. This new theory has had its influence in regard to the property rights affecting oil and gas lands. Since oil and gas are not as migratory as it was once supposed that they were, property owners have objected to adjacent property owners draining these minerals from under their lands under certain conditions. They maintain they have a right and title to all minerals beneath the surface of their lands.

The development of the science of geology therefore has brought into being two conflicting theories in the law relating to oil and gas rights. There are some who maintain that since oil and gas are minerals they are a part of the land. He, who owns the fee, also owns the oil and gas thereunder. Water and wild animals can be replenished by nature but oil and gas cannot. Also, the title to wild animals is in the public at large before capture. The title to percolating waters is never in the state or public at large. This is known as the "ownership" theory.

On the other hand, there are those who maintain that the fee owner's right is not in the oil and gas *in situ* but in the right to reduce to possession by drilling and bringing to surface any oil or gas found thereunder. Oil and gas are fugitive by nature and the only right the property owner has, is the right to bring them under his control when found beneath the surface of his land. Recent developments have disproved the theory that oil and gas are migratory. Oil and gas are impounded in subsurface reservoirs and remain there until released by drilling for them, or by some unusual natural event like an earthquake or landslide. There are courts who have held that the landowner has title to oil and gas in place, but the law seems to be settled that he cannot protect his title if they leave his land and pass to others. The "non-ownership" theory holds that the only right vested in the landowner is the right to drill and reduce to possession these minerals when found on his land.

One of the first cases of importance outlining the rights of oil and gas was Westmoreland and Cambria Natural Gas Company vs. DeWitt, [4] twenty years after the discovery of the first oil well. The doctrine as summarized in the following paragraph was established:

The learned master says gas is a mineral, and while *in situ* is part of the land, and therefore possession of the land is possession of the gas. But this deduction must be made with some qualifications. Gas, it is true, is a mineral; but it is a mineral with peculiar attributes, which require the application of precedents arising out of ordinary mineral rights, with much more careful consideration of the principles involved than of the mere decisions.

4. Victor H. Kulp, *Cases on Oil and Gas,* West Publishing Company, St. Paul, Minnesota, 1924, p. 1; 130 Pa. 235.

Water also is a mineral; but the decisions in ordinary cases of mining rights, etc., have never been held as unqualified precedents in regard to flowing, or even to percolating waters. Water and oil, and still more strongly gas, may be classed by themselves, if the analogy be not too fanciful, as minerals *ferae naturae*. In common with animals, and unlike other minerals, they have the power and tendency to escape without the volition of the owner. Their "fugitive and wandering existence within the limits of a particular tract was uncertain," as was said by Chief Justice Agnew in Brown vs. Vandergrift, 80 Pa. 147, 148. They belong to the owner of the land and are part of it, so long as they are on or in it, and are subject to his control; but when they escape, and go into other land, or come under another's control, the title of the former owner is gone. Possession of the land, therefore, is not necessarily possession of the gas.

Thus we have the common law doctrine giving the owner of the land the right to take from under the surface anything that might be found there and the right to reduce to possession any oil or gas that might be discovered by the owner of the land through drilling. This right of ownership is tested by the legal principle that the party claiming such ownership has such right or title to appropriate the oil or gas that no one can lawfully take it from him without his consent. Oil and gas are like wild animals as far as legal ownership is concerned. If these minerals are found under the land they may be reduced to possession by the owner of the surface. But if the oil and the gas migrate from beneath the surface to other localities the owner loses his title to them.

In the attempt to get oil and gas the right of the land owner to sink a well any place on his own land is conceded by the courts. This principle was laid down in Barnard vs. Monongahela Natural Gas Company.[5]

The conclusions of law were:

(1) That the drilling of the well on the farm of James B. Barnard by the defendant company and taking the gas therefrom in no way invades the plaintiff's property rights. (2) That the defendant company, under all the facts in this case, is not guilty of either actual or legal fraud in that it drilled the James B. Barnard well where it did and drained gas from the plaintiff's farm.

In the opinion the court said:

If, then the land owner drills on his own land at such a spot as best subserves his purposes, what is the standing of the adjoining land owner whose oil or gas may be drained by this well? He certainly ought not to be allowed to stop his neighbor from developing his own farm. There is no certain way of ascertaining how much of the oil and gas that comes out of the well was when *in situ* under this farm and how much under that. What then has been held to be the law? It is this, as we understand it, every landowner or his lessee may locate his wells wherever he pleases, regardless of the interest of others. He may distribute them over the whole farm or locate them on only one part of it. He may crowd the adjoining farms so as to enable him to draw the oil and gas from them. What then can the neighbor do? Nothing; only go and do likewise. He must protect his own oil and gas. He knows it is wild and will run away if it finds an opening and it is his business to keep it at home. This may not be the best rule; but neither the legislature nor our highest courts

5. Kulp, *Ibid*, p. 1; 216 Pa. 362; 65 Atl. 801.

has given us any better. No doubt many thousands of dollars have been expended "in protecting lines" in oil and gas territory that would not have been expended if some rule had existed by which it could have been avoided. Injunction certainly is not the remedy. If so, how far must the land owner be from the line of his neighbor to avoid the blow of "this strong arm of the law"?

This opinion was handed down in 1907. For many years there was no restraint placed on the flow of oil and gas wells and the owners could let them flow openly, physically wasting the mineral, even though adjoining property owners protested.[6] However, in the interest of conservation of resources practically all of the oil producing states today have statutes regulating the operation of oil and gas wells, in the interest of the public if not in the interest of the adjacent property owners. These laws will be discussed in a subsequent chapter.

One of the earlier cases supporting the ownership theory was Preston vs. White.[7] In this case the court compared oil and gas to solid minerals. The co-tenants had property interests therein amounting to property rights since their interests could be partitioned. The court went on to say that a landowner does not have legal relations in oil and gas necessary to constitute him owner of them yet he may create such an interest in his grantee.

In Texas Company vs. Daugherty[8] the Texas court also sustained this theory. The court said:

While they lie within the ground as part of the realty, is the ownership of the realty to be denominated, as to them, a mere license to appropriate, as distinguished from an absolute property right in the *corpus* of the land? With the land itself capable of absolute ownership, everything within it in the nature of a mineral is likewise capable of ownership, so long as it constitutes a part of it. If these minerals are a part of the wealth while in place, as undoubtedly they are, upon what principle can the ownership of the property interest, which they constitute, while they are beneath or within the land, be other than the ownership of an interest in realty?

In Ohio oil and gas in place are the same as any part of the realty, and capable of separate reservation or conveyance.[9] This point of law was brought out in Pure Oil Company vs. Kendall, 116 Ohio 188. However, in another case the non-ownership theory was held.[10] According to the Kentucky court the owner of land may by the execution and operation of a lease of the minerals thereunder, segregate, entirely or partially, the minerals under it, and thereby separate them as a distinct item of property from the land.[11]

Texas has numerous decisions supporting this theory. In Stephens County vs. Mid-Kansas Oil and Gas Company the court held that gas and oil

6. 157 Pa. 324.
7. Preston vs. White, (1905) 57 W. Va. 278.
8. Texas Company vs. Daugherty, (1915) 107 Tex. 226.
9. Victor H. Kulp, *Digest of Oil and Gas Decisions,* Bobbs-Merrill Company, Indianapolis, par. 19.
10. 57 Ohio St. 317.
11. Kulp, *ibid,* par. 18.

in place are minerals and realty, subject to ownership, severance and sale, while imbedded in the sands or rocks beneath the earth's surface, in like manner and to the same extent as is coal or any other solid mineral.[12] Again in Lamber vs. Gant, oil and gas in place constitute real property and as such are subject to ownership and conveyance in accordance with the rules regulating the ownership and conveyance of that class of property.[13]

The weight of authority, by numbers and by dignity of the courts, is that the only right that the land owner has is the right to reduce any oil or gas found beneath the surface of his land to possession by drilling for them and bringing them to the surface. The non-ownership theory is recognized by the United States supreme court,[14] Oklahoma,[15] Louisiana,[16] Illinois,[17] and New York.[18]

According to the supreme court of the United States[19] an individual has exclusive right on his own land to seek for oil and gas, but they do not become his property until actually he has obtained them. The court went on to show that while there were some elements in common between oil and gas and animals *ferae naturae* there is no identity between them. In each case the owner of the soil has the right to reduce them to possession when found on his land but in things *ferae naturae* anyone has the power to reduce a portion of the public property to private ownership by gaining possession of them. Animals *ferae naturae* are public property. In the case of natural gas and oil no such right exists in the public. It is vested only in the owners in fee of the surface of the earth. Since the wild animals are owned by the public the individual may be prevented by law from seeking to reduce them to possession. Such an act by the legislature would not deprive one of private property because the public are the owners. It is but the discharge of the governmental trust resting in the state as to property of that character.

In regard to the reduction of oil and gas to possession by the surface owners, to deprive them of this right would be to deprive them of private property. There is a co-equal right of all surface owners of a piece of land overlying an oil or gas pool to take from the common source of supply the two substances which in the nature of things are united though separate.

The court went on to say:

Viewed, then, as a statute to protect or to prevent the waste of the common property of the surface owners, the law of the state of Indiana which is here attacked because it is asserted

12. Kulp, *ibid,* par. 27.
13. Kulp, *ibid,* par. 28.
14. 177 U. S. 190.
15. 177 Pac. 86.
16. 150 La. 765; 88 So. 723.
17. 233 Ill. 9; 84 N. E. 54; 84 N. E. 48.
18. 38 Hun. 37; 23 L. R. A. 437.
19. Ohio Oil Company vs. State of Indiana, (1900) 177 U. S. 190; Kulp, *Cases on Oil and Gas,* p. 11.

that it divested private property without due compensation, in substance, is a statute protecting private property and preventing it from being taken by one of the common owners without regard to the enjoyment of the others. Indeed, the entire argument upon which the attack on the statute must depend involves a dilemma, which is this: If the right of the collective owners of the surface to take from the common fund, and thus reduce a portion of it to possession, does not create a property interest in the common fund, then the statute does not provide for the taking of private property without compensation. If, on the other hand, there be, as a consequence of the right of the surface owners to reduce to possession, a right of property in them in and to the substances contained in the common reservoir of supply, then, as a necessary result of the right of property, its indivisible quality, and the peculiar position of the things to which it relates, there must arise the legislative power to protect the right of property from destruction.

There is property in the surface owners in the gas and oil held in the natural reservoir. Their right to take cannot be regulated without divesting them of their property without adequate compensation, in violation of the fourteenth amendment, and this although it be that if regulation cannot be exerted one property owner may deprive all the others of their rights, since his act in so doing will be *damnum absque injuria.* This is but to say that one common owner may divest all the others of their rights without wrongdoing, but the law-making power cannot protect all the owners in their enjoyment without violating the constitution of the United States.

Among the decisions handed down by the state courts the opinion of the supreme court of the state of Louisiana in Frost-Johnson Lumber Company vs. Salling's Heirs[20] is one often cited and relied on. It is also one of the most recent, being handed down in 1922, twenty-two years after the decision of the supreme court in Ohio Oil Company vs. Indiana.

In this case the Louisiana court said:

We, therefore, hold that it is the settled jurisprudence of this state that oil and gas in place are not subject to absolute ownership as specific things apart from the soil of which they form part; and a grant or reservation of such oil and gas carries only the right to extract such minerals from the soil. . . . . We may hold and we so hold, that no matter what the intention of the parties be, the owner of lands cannot convey or reserve the ownership of oils, gases, and waters therein apart from the land in which they lie; and we so hold, because the owner himself has no absolute property in such oils, gases, and waters, but only in the right to draw them through the soil and thereby become the owner of them. The intention of the parties has therefore nothing whatever to do with the holding; the principle involved being that no one can convey to another any greater right than he himself has.

It is thought by some authorities that there is not such a wide difference between "ownership" and "non-ownership" theories as the court decisions might indicate. The variations are due to the different interpretations of the words "property," "title," and "ownership."

According to Professor Summers:[21]

It is believed that much of the confusion and apparent contradiction relative to the nature of the legal interest created by grant or exception of oil and gas is due to the misuse of such

20. Kulp, *Cases on Oil and Gas,* p. 33; 150 La. 756.
21. Walter L. Summers, *A Treatise on the Law of Oil and Gas,* Vernon Law Book Company, Kansas City, 1927, p. 135.

terms as "property," "title," and "ownership." The nature of the landowner's interest in oil and gas, and of the interest which he may create in others, is necessarily determined by what the courts have held that he may and may not do, and what others may and may not do as against each other, in respect to the oil and gas under his land. In referring to the interest, some of the courts have said that the landowner or his grantee has a title in the oil and gas; others have said that he has a privilege to take them and such privilege is exclusive, meaning thereby that he has a right that others shall not take by operations on his land; and still others have said that he owns the oil and gas. It is believed that in most of these instances the courts meant about the same thing; that is, that the landowner, although his legal relations in respect to oil and gas are not such that he may be said to own the oil and gas that is actually under his land, nevertheless has privileges of taking them and rights that others shall not take them, and that these relations create in him a property interest; that his property interest can be transferred to another in fee or for life. It is believed that in none of these cases, except in Louisiana, has it ever been really necessary for the courts to say whether this interest is of the ownership or non-ownership class; that is, *jura in re propria, or jura in re aliena.*

The concept of property in the ownership theory is entirely different from the concept in the non-ownership theory. In the former oil and gas are corporeal property, in the latter they are incorporeal property. Corporeal property is physical property. Incorporeal property is a right of acquisition—the right to acquire legal control of something not yet owned or even in existence. Oil and gas, physically, are in existence, but here it is implied, when it is said they are not in existence, that they will come into possession at some future time. This right to future possession is incorporeal property. This right may by proper conveyance be separated from the rest of the land. While some courts have held that the landowner has title to oil and gas in place he would have difficulty in any court to establish his title to oil and gas after it has passed from his land to another's. "He can convey to no one a better title than he himself has."

Out of these court decisions have come the working rules, the usages and customs that are now strongly entrenched in the industry. It is these working rules that have brought about the present unstabilized condition in the oil industry. The right to drill when and where one pleases on his own land, or convey this right to another, as guaranteed by the courts, is the principle cause of overproducton in the industry. This condition is not due altogether to acquisitiveness on the part of the owner of these rights. More often than not he is compelled to drill in self defense. A derrick is erected and the drill goes down on a neighboring tract of land; oil is found. There is no other way for him to protect himself, according to the courts, than to go and do likewise or else the oil and gas under his land will be drained away.

This philosophy of ownership of oil and gas rights has brought about a tremendous economic and physical waste in the petroleum industry. The amount of waste resulting from this principle is impossible to estimate. An

example, however, may be appropriate here to show how waste occurs. In the Garber and Thomas deep sand pools opened in northern Oklahoma in 1925, a 2,800 barrel well was discovered in April that year at a depth of 4,380 feet. This well, the discovery well, was in the Garber pool. The land in this region is held in one hundred and sixty acre tracts. The cost of drilling a well in this territory is approximately $75,000. In spite of the fact that the land was held in fairly large size tracts and the importance of the discovery well was yet unknown, thirty-six additional tests were started at once, representing a total cost of $2,500,000.

A 4,000 barrel well was discovered May 9, 1925, in the Thomas pool, eighteen miles from the Garber pool, at a depth of 3,955 feet. Before a second well was completed twenty-seven tests had been started. Most of them were either dry or so small as to be non-commercially productive. This type of development is not peculiar to northern Oklahoma but is the characteristic procedure wherever competitive drainage exists.[22]

Manner of Securing Right to Drill for Oil or Gas

Oil and gas are held underground, according to modern authorities on petroleum geology, in reservoirs varying in size and under great pressure. This pressure ranges from 200 to 1500 pounds to the square inch according to the depth. The oil and gas occupy spaces in rock of varying degrees of porosity. Productivity of the pool varies directly with the porosity of the strata containing the petroleum. Unless it is a very large tract of land controlled by one person, either individual or corporate, the oil pool underlies the land of several persons. Most frequently the area overlying an oil pool is considerably cut up as to ownership. When the reservoir is punctured by the drill the pressure forces the oil and gas to the outlet. This drains the oil from under adjacent lands. As more wells are drilled and outlets made the less the pressure becomes. It is the gas pressure that forces the oil to the surface. Naturally the owner of the oil and gas rights on adjoining properties are desirous of protecting their interests so they are forced to drill to keep the oil and gas from being drained from under their land. According to current estimates only about fifteen to thirty per cent of the oil is brought to the surface under present methods. Since each person interested wants to get his part of the production and since the drilling of more wells lowers the pressure the result is more oil is left in the ground. Therefore, the legal principle upon which oil and gas rights are based is the underlying cause of competitive drilling and its attendant physical and economic waste.

Since the element of uncertainty is great in the location of oil, producing companies and operators scatter their interests over wide areas in order to

22. Earl Oliver, "Law on Oil Is Premium on Waste," *The Oil and Gas Journal*, February 18, 1926, p. 174.

reduce the risk. They do not carry all their eggs in one basket. This fact causes a wider diversification of the ownership of oil and gas rights in any one region. A map of any oil region where the land is privately owned will show how the operators "checkerboard" their interests. Rather than put all their chips on one number or on one color they scatter them over the board. Once oil and gas are discovered the price of leases and royalties increase rapidly and there is a scramble among the operators "to get in on production."

The right to explore for oil and gas on a given tract of land may be secured in the following ways: (1) purchase of the fee, (2) purchase of the oil and gas mineral rights, (3) lease of the oil and gas rights, and (4) assignment of either one of the above from the previous holder.

The purchase of the fee is usually resorted to where land is cheap and it is as easy to acquire the mineral rights through the outright purchase of the land as it is to lease the land or buy the exclusive mineral rights. Sometimes land may be bought to avoid an exaggerated idea on the part of the land owner of the value of the land if he knew the purchaser desired it for the purpose of exploring for oil and gas. The disadvantages attached to buying the fee is that much land suitable for agriculture would be brought into the control of the oil companies and since they are not in the farming business they do not care to look after the agricultural possibilities of the land. Another disadvantage in buying the land outright is it takes over the duty to pay real property taxes which would be an added burden on the oil companies. In Oklahoma the holder of the oil and gas right pays no real property tax. However, there is a three per cent gross production tax in lieu of advalorem taxes.

California is the only state where the oil interests own the fee to any considerable degree. This is due to the fact that land in the states east of the Rockies was cut into smaller tracts, with the exception of public lands and large ranches in the southwest, and was employed in some form of agriculture. On the public lands east of the Rockies the most practical way to obtain a permit to drill for petroleum is to obtain a lease. Likewise, it is more economical to obtain a lease on the large ranches than it is to buy them. The early mining laws of the United States have also contributed to the extensive fee holdings of oil companies in California. There are some striking exceptions to the large tracts of land owned by companies in the Pacific Coast fields. The town lot drilling of Santa Fe Springs is an example. If the oil and gas rights on large bodies of land were owned by companies the evils of competitive drilling would be largely eliminated.

The right to explore for oil and gas may be transferred by a mineral deed. This right has been recognized by the courts in all states. The mineral rights are more frequently called royalties. Royalty, as a word, had its origin

in the Middle Ages when the crown claimed and collected a tribute from those who tilled the soil. Through the process of evolution, as mentioned above, these rights were wrested from the crown and now rest in the citizen who owns the land.

As a rule the producing companies and operators are not interested in buying the royalty rights. A lease can be purchased from the royalty owner for less money. If the well results in a dry hole the prospector is not out so much capital. It is customary in a lease contract to give to the royalty owner a portion of the oil produced. This amount varies in different places. In the Mid-Continent area the customary interest is one-eighth. In the Osage nation and in California it is one-sixth. There is a sliding scale for royalties on government lands depending on the location and quantity of oil produced. Frequently special provisions are made in regard to the royalty payment for gas.

While the lease calls for a certain portion of the gross receipts of oil and gas, the payment is not often made in kind but all the production from the well is sold and the payment is made in cash.

Since 1920 the business of buying oil and gas royalties has experienced a rapid growth. Large companies have been organized for the purpose of encouraging investments in this phase of the oil business. The average landowner is ignorant of the true value of his mineral rights. He either disposes of them for a nominal sum, especially if he is a farmer and the crops are a failure, or he has an exaggerated idea of the value and often holds his interest too long. The test well proves to be a failure and the value of his royalty drops to nothing. The best plan for the fee owner to follow, under the present system, is to sell off small portions as the demand for royalties increases until he has disposed of one-half and then hold the other for later developments. When fractional royalty interests are sold they are usually undivided interests in the whole tract of the fee owner.

The tendency in recent years to divide the royalty interests into very small fractions is a handicap to the present stabilization movement. The purchaser of these interests buys them for the purpose of receiving a return out of the production of oil. Royalty interests are bought, subdivided, and sold at higher prices to the small investor.

The smaller the investor, usually the more impatient he is in awaiting development. The greater the number of interests involved the greater the problem in securing concerted action toward any stabilization program.

The want-ad columns of any newspaper published near the centers of oil activity will reveal the extent to which this practice is carried. Here are a few sample advertisements picked at random from the *Oklahoma City*

Times. However, these are modest in the fractional interests offered for sale.

For sale, one-sixteenth royalty under one well.
Royalty, five or ten acres, $600 per acre
_____townsite offers surest and best opportunity to make money in oil; big production; no dry holes.
One-tenth of an acre in 3-10-2 for $50.
Small investor's chance. One to five acres in 32-11-2 west.
Three-eightieth acre royalty under 320 acres, 19-11-2, $1,100.
Royalty by owner; one-fifteenth acre; $60.
Few interests under drilling well at Earlsboro; only 150 feet from 2,000 barrel well.
Something for the small investors; $50 units covering two good locations.
One-five-hundredth interest in sixty-eight acres; phone owner.
One-fifteenth in_____location; $100 per unit.

There is another movement more encouraging in the Mid-Continent area. This movement was initiated by the leaders of the Farmers Union, a little more than a year old, to persuade the farmers to pool their royalty interests.

There are five pools now operating in Oklahoma, Texas, New Mexico, and Kansas. The Kansas pool is sponsored by the Kansas Farmers' Union. In brief, the farmers pool their royalty interests in one organization. Rentals, bonuses, and production interests from the lands in the pool are distributed among the farmers in proportion to the amount of land each contributes toward the whole. This movement has made considerable headway in the counties of western Oklahoma where production is low and hopes are high. A co-operative plan of this nature works better on the outer fringe of the oil area. Where the chances are favorable for production the royalty owner is hesitant to enter into any kind of co-operative scheme. The Kansas pool has acquired 10,480 acres of royalty under a spread of 20,960 acres. The Texas group has 443 tracts with 104 under lease. The New Mexico organization has 260 tracts under 33,932 acres with forty-two tracts under lease.

It is too early yet to make an appraisal of the importance of this movement. None of the land under control of these pools is in important territory at this time. Should large producing areas be found in their territory they can be a powerful factor in either encouraging or retarding any kind of stabilization program. If the acquisitive instincts get the better of the judgment of the leaders and the members of the respective pools they will do more harm than if they were never organized because organized efforts for good or for evil is more powerful in its influence than unorganized efforts. On the other hand, if through co-operative effort the drilling programs are carried on along scientific lines, both in engineering and economics, they will set a pattern for the world to follow and furnish an example for others where

the stabilization program is carried on according to present property rights and where government intervention is reduced to a minimum.

The Lease and Its Provisions

The most common form of obtaining oil and gas rights is through the lease from the royalty owners which may be extended over any period of time, usually for five or ten years. The lease is a right to go on another's land and explore for oil and gas and reduce them to possession. The oil lease is the basic contract of the oil industry. Oil companies maintain special land departments whose function it is to buy the leases and attend to their management as far as the oil and gas rights are concerned. The modern oil lease is a product of past experience. As a byproduct to the oil industry there has developed alongside of it an extensive business in the buying and selling of leases as well as royalties.

The first oil lease for which we have any record was made six years before the first oil well was brought in. It contained most of the essential elements of the modern oil lease but it is as out of date as the age in which it was written. The lease reads as follows:

Agreed this, the fourth day of July, A. D., 1853, with J. D. Angier of Cherrytree township, in the County of Venango, Pennsylvania, that he shall repair up and keep in order the old oil springs on land in said Cherrytree township, or dig and make new springs, and the expense to be deducted out of the proceeds of the oil, and the balance, if any, to be equally divided, the one-half to J. D. Angier and the other half to Brewer, Watson and Company, for the full term of five years from this date, if profitable. Signed Brewer, Watson and Company and J. D. Angier.[23]

According to the usual requirements in the modern lease the lessee, J. D. Angier, got the best of this deal. There was no obligation to drill a well. No royalties were to be paid the lessor until the expenses incurred in securing the oil had been met. However, after Drake's discovery well when the demand for oil bearing properties began to expand rapidly the owners tightened up their requirements. There were no printed forms in those days for the convenience of the parties to the lease contract. They drew up their leases on the most convenient paper they could find at hand. There was no uniformity as to size or quality and it varied from scrap paper to foolscap.

Considerable refinement in form is shown in the McClintock lease dated August 18, 1860.[24] It was made out from George W. McClintock and wife, as lessors, to Sarah L. Brown, Phidelia Brown and Eli D. Cathir as lessees. for full and exclusive privilege of boring and digging for oil or other mineral. . . . . .the use of land to erect vats and necessary buildings. . . . . The parties of the second part shall and will commence operations on said leased land within one week preparing to bore well No. 1, said work to be prosecuted faithfully until oil is found in paying quantities or abandoned.

23. *The Oil and Gas Journal,* March 27, 1924, p. 28.
24. "Col. Drake's Own Story," *The Lamp,* June, 1929, p. 15.

The consideration was $100 cash down and $100 within ninety days. The lessees also agreed to pay $800 if they obtained an average production of eight barrels a day for the first thirty days of pumping, and to deliver half of the oil in the vats to the lessor in barrels furnished by the latter.

Thus we see that from the very beginning the terms of the lease have been one of the most dominant causes for the overproduction of oil due to the drilling requirements. This lease, however, is more exacting than the ordinary lease of today. The lessee in this case had only one week in which to begin drilling operations.

In a lease dated December 30, 1857,[25] between the Pennsylvania Rock Oil Company and E. B. Bowditch and E. L. Drake there is a clause calling for a rental of one-eighth of "all the oils collected from the spring in barrels furnished or paid for by the lessee." This evidently is the beginning of the customary payment by the lessee, even until today, of one-eighth of the proceeds from the well to the royalty owner. In those days, according to the late Colonel Patrick C. Boyle, founder of *The Oil and Gas Journal* and editor of the Oil City, Pennsylvania, *Derrick*, there was no uniformity in agreement in leases made in the early days of the industry. The royalties varied from one-eighth to one-half of the oil produced and, in addition, large cash bonuses were often paid. Frequently the land was bought outright for the purpose of oil development or to lease to other operators.

It was a common practice even at this time to found speculative oil companies, on the strength of a very small fractional interest in some noted flowing well. These companies were capitalized in large amounts and their capital stock found ready sale in all parts of the country. With the collapse of the speculative oil bubble early in 1866 the oil industry began to assume a more settled attitude and the day of extravagant terms on small oil leases was passed for a while. With the advent of the Bradford field in the early 70's farm leasing became the prevailing practice.

The prevailing geological theory in those days was that oil was found under low, level stretches of ground close to the bank of running streams of water. This was no doubt due to the fact that large numbers of oil seepages were found at the waters' edge.

The custom of making cash payment in lieu of operations within a specified period was made as early as 1860. The first lease on record to mention plugging wells was issued in 1865 and the first lease to provide for the seed bag to pack off water was made the same year. The early leases in the early 70's were very voluminous with clauses dealing in great detail with the division of oil, right of inspection by the lessor, payment of taxes, specifications

25. "Evolution of the Oil and Gas Lease," *The Oil and Gas Journal*, October 1, 1925, p. 106.

concerning the operation of the well, subletting, and many other clauses. The leases in this period were very cumbersome in their wording due to the efforts of the lawyers to protect their clients.

One lease made in 1875 has exceptional merit and if this type were employed today the problem of stabilization would become simpler. It demands that operations shall not be started until oil has reached $3.00 a barrel and has remained at or above that price for three months steady and firm.

C. D. Angell is given the credit for originating the oil belt theory. Isaac N. Phillips was one of the first to make a practical application of this theory upon a large scale, and the first to conceive of the basin theory in connection with the oil belts, or in other words, that an oil field was composed of a succession of detached basins or pools, rather than a continuous belt extending in a given direction through a considerable section of country.[26]

Although the oil and gas lease is the basic contract of the industry, the progress of its development has been slower than has been the technical progress. Beginning with the use of the printed form the character of the lease has been fairly well standardized. From time to time changes in the principal clauses have been made and new ones added. The character of the fields and the laws of the respective oil states have yielded their influence, also, on the lease.

The modern lease contracts may be divided into three broad classes: (1) leases on private lands, (2) leases on Indian lands, (3) leases on public lands, federal and state.

Until 1924 the most common form of lease in the Mid-Continent territory was the Producers' 88. This type of lease did not meet adequately the needs of the operators. In response to the demand for a new form that same year a committee appointed for the purpose by the Mid-Continent Oil and Gas Association drew up a new form called "Mid-Continent 88." This is one of the most popular forms used by the industry today. The Mid-Continent field covers a wider area than do any of the other fields in the United States so it is safe to say that this type of lease is used more than any other in the United States. Outside of the date and the parties named in the contract there are sixteen clauses which have been added to the lease from the fruits of experience.

The gist of the contract is contained in the first clause which reads,

that lessor, for and in consideration of the sum of _____ dollars in hand paid, and of the covenants and agreements hereinafter contained to be performed by the lessee, has this day granted and leased and hereby grants, leases and lets unto the lessee for the purpose of mining and operating for and producing oil and gas, casinghead gas and casinghead gasoline, laying pipelines, building tanks, storing oil, building power stations, telephone lines

26. *Ibid*, p. 274.

and other structures thereon to produce, save, take care of and manufacture all of such substances, and for housing and boarding employes, the following described tract of land in ----------.

No matter how many tracts of land described in the lease it is yet one lease. This form provides that the lease shall remain in force for a period of ten years and as long thereafter as oil, gas, casinghead gas, casinghead gasoline, or any of them is or can be produced.

The fifth clause in the lease is a very important one. The terms of this section put the lease in the "unless" class. Leases are known as "unless" or "or" leases. An "unless" lease provides, in substance, that it shall terminate on a certain day or at a certain time "unless" the lessee commences a well, completes a well, or pays rental. It creates an option on the part of the lessee to hold that lease by either drilling or by paying, and if he does neither the lease automatically terminates, as he is not obliged to do either. The "or" lease provides in substance that the lessee agrees to drill within a certain time "or" pay a rental. If he chooses he can insist on a forfeiture. If he fails to pay the rental the lease does not terminate automatically, and the lessor may sue the lessee to collect the rental. He is obligated to perform one of the two acts, drill or pay. By means of a surrender clause, however, the lessee can relieve himself of liability for future rentals by avoiding himself of the right to surrender usually upon payment of a nominal sum.

The principal points in the remaining clauses relate to payment of royalties, cancellation of the lease, method of payment of rentals, and guarantee of title by the lessor.

Oil companies taking original leases are generally using the Mid-Continent 88 form, but when they take leases by assignment they find that almost any form that was obtainable by the lease broker may have been used. This condition makes it very difficult for producing companies to carry out uniform programs.

As a factor in the promotion of stabilization the future lease should provide that, in the event of overproduction occasioning congestion of pipeline and storage facilities in the field and the demoralization of prices, a moratorium would be declared and the operator be relieved of drilling obligations until economic conditions warranted development.

The Pool as the Unit of Production

The chief stumbling block in the way of stabilization is the fact that the unit of production is the individual lease on individual pieces of property. This is the result of the evolution of property rights in the United States. The unit of production should be the pool. Attempts have already been made with varying degrees of success in this direction. This plan of development is called the community plan.

One of the earliest attempts in this direction was made by the Union Oil Company of California. After bringing in a large gasser on the Wellington Dome in Colorado this company developed the idea of using the community plan of development which would eliminate much wasteful offset drilling and at the same time insure for the landowners involved a fair distribution of royalties. The chief difficulty in a plan of this kind is the working out of distribution of royalties equitable and satisfactory to all the royalty owners. The greater the number of owners the more difficult it is to reach an agreement.

The plan followed by this company was unusual in that it adopted an entirely new method for putting all interests on an equitable basis, and was put into operation even after the entire dome had been leased individually. The outline of the structure had been contoured closely by surface geology prior to discovery of the gas so all that was necessary to put the plan in operation was to choose a contour line, which was considered to be the limit of probable production. All the lands within this line were unified under a community lease, while those lands situated outside were left under their original leases. The key to the plan lay in the working out of a unit basis in which the individual lease owner acquired an interest in the community lease in proportion to the ratio of the acreage in the single lease to the acreage in the community lease. The landowner then would receive a royalty on his tract of land regardless of whether or not a well had been drilled upon it, provided royalties were due under the community lease.[27]

The advantages of this method of operation to the company are: (1) Elimination of unnecessary offset drilling, (2) simplification of royalty accounting, (3) the saving of gas pressure, (4) which increases the production of oil. The advantages to the landowner are much the same as those of the operator. While his interests are pooled with those of the group in the long run it results in a benefit to all. Usually when a well is brought in on the land of a man who has entered into a pooling agreement he regrets having entered into the plan for otherwise he would have gotten a greater share of the oil out of the well. The saving of gas pressure resulting in an increase in production from the unit will likely prove in the long run that the royalty owner will receive more returns than when operated as an individual enterprise. Offset wells would reduce his income. Community leasing and unit operation of oil properties will be discussed in greater detail in a subsequent chapter.

27. Fay L. Wright, "Many Ills of the Oil Industry Will Yield to the Community Lease," *National Petroleum News,* February 24, 1926, p. 40-E; Tolbert R. Ingram, "New Plan Community Lease Will Aid in Cheaper Oil Recovery," *National Petroleum News,* May 7, 1924, p. 77.

Regulations Regarding Indian Land

Since the Indian is a ward of the United States the supervision of the oil and gas rights on Indian lands has remained with the government. One of the earliest acts relating to the disposition of oil and gas rights on these lands was passed in February, 1891.[28]

These laws vary according to the tribe and reservation. Much oil has been found on Indian land, especially in Oklahoma. However, little attempt has been made, so far, on the part of the government to control production with the view of assisting in the stabilization of the industry, or, if preferred to state it another way, in the conservation of these resources.

Regulations governing the disposition of oil and gas rights on Indian lands may be divided into three classes: (1) Laws relating to the lands of the Five Civilized Tribes in Oklahoma. These tribes include the Cherokees, Choctaws, Chickasaws, Creeks, and Seminoles. (2) Laws governing the oil and gas rights on the lands of the Osage Indians in Oklahoma. (3) This class has to do with the unalloted lands of all Indians not included in the two classes above.

Thus far, oil from Indian lands other than those of the Osages and Five Civilized Tribes has not been of great importance viewing the industry as a whole. A great deal of discretionary power is vested in the secretary of the interior. Should oil production on these lands become an important factor the secretary of the interior under the present law would have considerable power in regulating and controlling their development.

According to the act of May 29, 1924.[29]

unallotted land on Indian reservations other than lands of the Five Civilized Tribes and the Osage reservation subject to lease for mining purposes for a period of ten years under the provision of section 3 of the act of February 28, 1891, may be leased at public auction by the secretary of the interior, with the consent of the council speaking for such Indians, for oil and gas mining purposes for a period not to exceed ten years, and as much longer thereafter as oil and gas shall be found in paying quantities, and the terms of any existing oil and gas mining lease may in like manner be amended by extending the term thereof for as long as oil and gas shall be found in paying quantities.

According to the regulations governing the leasing of tribal lands for mining purposes under this land and approved by the secretary of the interior July 23, 1924, a lease containing not more than 4,800 acres may be bought at auction where the lease is not on a known structure containing oil and gas provided the lessee shall proceed at once to develop the leased tract in order to ascertain whether there is paying production. Six hundred and forty acres is the maximum amount leased, according to this law, where the lease is on a known structure.

28. 26 Stat., 795.
29. Public No. 158, sixty-eighth congress.

Exploratory oil and gas leases contain such drilling obligations and other terms and conditions as the secretary of the interior in his discretion may deem necessary in each particular case to secure a proper test on the leased area. On the other oil and gas leases the lessee shall exercise diligence in sinking wells for oil and natural gas on lands covered by his lease and shall drill at least one well thereon within one year from the date of approval by the secretary of the interior to a depth specified in the lease. However, the secretary may, in his discretion, upon application of the lessee, extend the time within which any well shall be drilled on the payment of an annual rental of $1.00 an acre for each whole year the completion of the well is delayed.

Under this law the secretary of the interior is clothed with a great deal of power. Should oil from these lands become the determining factor in the industry a conservation-minded secretary could exercise his power for good. Some have held this office that were not inclined in this direction.

The regulations governing the leasing of oil and gas lands in the Crow reservation in Montana and the ceded lands of the Shoshone and Wind River reservation in Wyoming deals specifically with the problem of conservation of the oil and gas resources. These regulations have to do with production methods affecting underground waste. The drilling of any well into producing sand is prohibited in the Shoshone reservation when in the opinion of the government oil and gas inspector the marketing facilities are inadequate, or insufficient provision has been made for controlling the flow of oil or gas reasonably to be expected therefrom, until such time as suitable provision can be made.

It is the duty of the inspector to determine when a well can be drilled deeper and under what conditions a producing well or sand may be abandoned. A limit may be made to the percentage of open flow capacity of any well which may be utilized when such action is necessary to protect properly the gas-producing formation. The lessees are required to separate the oil and gas when both are produced in commercial quantities from the same formation, or under such conditions as might result in waste of oil or gas in commercial quantities.

The land of the Osages has produced more oil and gas than that of any other tribe. Figures of the American Petroleum Institute show that bonuses paid on leases in the Osage Indian reservation have totaled $108,000,000 over a period of sixteen years, while royalty payments on oil, gas and gasoline have netted the Osage Indians $113,000,000 in twenty-seven years.

The surface rights to land in this reservation are allotted to members of the tribe in severalty. The mineral rights are held in common. Leases are

sold at public auction at regular intervals at Pawhuska, capital of the tribe. There is one peculiarity to leases in this area, in that leases on oil and gas are sold separately. The producer of the oil does not own the gas and *vice versa*. There is no limit to the number of acres any lessee may acquire, by lease or assignment, for oil mining purposes on the west side of the reservation. On the east side no person, firm, partnership, joint stock association, or corporation will be permitted to acquire or hold any interest in Osage lands for oil mining purposes by lease, assignment, drilling contract, or otherwise in excess of 20,000 acres. Any lessee may acquire, in addition to any acreage theretofore obtained 2,400 acres by assignment, without regard to the state of development of the property assigned, the same to be counted as part of the 20,000-acre limit. Such lessee may acquire also by assignment in case where wells on any quarter section are capable of averaging not more than three barrels *per diem* without other limit than the 20,000 acres.

Congress has put the burden of stabilization as far as the Osage lands are concerned, on the industry. In an act approved March 2, 1929, a minimum of 25,000 acres belonging to this tribe must be offered for sale annually. Production in this area is fairly well settled. The leases are owned and controlled by the stronger companies. The price of the leases, especially those on the west side, is beyond the reach of the small operators. The price of leases on one hundred and sixty acre tracts frequently approaches the $2,000,000 mark. Leases sold at auction between $100,000 and $750,000 are common. On the other hand, there are some leases that have gone at the auction sales for less than $1,000. These leases were priced low because of their geological location.

Since this area is under control of the big companies, and since the big companies are the ones in the industry most interested in stabilization, oil from these lands are not at the present time a disturbing factor. Production of oil from the Osage lands has been declining in recent months (1930), much to the inconvenience of the members of the tribe and the white people living off them, so the industry as far as this region is concerned is already fairly well stabilized. Practically the same regulations concerning physical waste obtain in this region as in the Crow and Shoshone reservations.

The situation relative to oil and gas rights in the Five Civilized Tribes is different from that prevailing among the other tribes. Each member of the tribe before the Indian Territory was admitted to statehood jointly with Oklahoma Territory was given an allotment which carried with it both surface and subsurface rights. There are some exceptions to this statement but they do not bear directly on the question of oil and gas rights.

The members of each one of these tribes are divided into two classes, restricted and unrestricted Indians. The unrestricted Indians have the same

privileges in disposing of their properties as have the white citizens of the state. Leases on the lands of the restricted members of the respective tribes must be approved by the department of the interior. These leases are not sold at auction but approval or disapproval is given to each one separately as applications are filed. Under the present law there is not much that can be done by the government in regulating these rights as far as the stabilization of the industry is concerned. The secretary of the interior has the authority to issue regulations concerning physical waste, but there is little he can do, once the rights to the oil and gas get under the control of the operators, to control production or further the cause of stabilization.

Leases on Public Lands

Leases on public lands fall into two general classes, federal and state. Practically all the federal oil lands are in the Rocky Mountain and the Pacific coast fields. There is considerable state land in the Mid-Continent area as well as in the far-eastern states on which oil, or gas may be found. A large part of this land is school land, set aside at the organization of the state government for the support of public education.

Texas has set aside for its university more than 2,000,000 acres of lands. About 250,000 acres are in the producing area. There are under lease, subject to prospecting purposes, about 150,000 acres leaving about 1,500,000 subject to lease. At the present time the leases on University land that are being sold are made under a "three-year term." This is entirely too short a period for a lease. If the state of Texas desires to encourage any kind of stabilization program it will be necessary for the leases on public lands to cover a longer term. A short term lease frequently forces the lessee to drill sooner than he would otherwise, especially in periods of overproduction. Leases on public lands should run not less than five years.

The school land department of the state of Oklahoma, according to its annual report, June 30, 1929, owned on that date 691,395 acres of land in fee simple, of which there were leased for oil and gas approximately 100,000 acres. Eighty-one tracts comprising 17,861 acres were producing oil and gas. The total amount of money received by this department during this fiscal year from bonuses, rentals, and royalties, totaled $850,033.56. This left available for lease approximately 600,000 acres. Leases on some of this land have been offered to the public at auction since July 1, 1929. The leases on state lands in Oklahoma run for longer periods of time and, therefore, are not as big a menace to stabilization as are the leases on school lands in Texas.

The first general law under which title could be acquired to mineral lands in the western states and territories was the act of July 26, 1866. This enactment was very imperfect. Because of the wide variation in opinion in

regard to public land among the westerners and between the east and the west it was difficult to secure a law satisfactory to all. This act did establish certain fundamental principles which quieted to some degree the uncertainty existing in the minds of the miners as to their rights to conduct operations on the public domain.

Congress on July 9, 1870, passed an act supplementing that of July 26, 1866. It provided that placer deposits should be subject to entry and patented in the same manner for lode claims provided in the previous act. The extent of a placer location was limited to one hundred and sixty acres, whether the location was made by an individual or an association of persons.

Another act was passed by congress on May 10, 1872, supplanting the acts of 1866 and 1870. The act continued in force with some amendments until superseded by the leasing act of February 25, 1920, providing that all mineral deposits in land belonging to the United States were open to exploration and purchase. It also limited the quantity of land which might be acquired by an individual under a placer location to twenty acres. It provided for obtaining title to lodes known to exist within placers. The law provided for the amount of annual work to be performed in order to maintain locations. Provisions were made for the marking of the boundaries of claims and proceedings necessary to obtain patents and for the determination of adverse claims were outlined.

Oil lands were not mentioned specifically in this legislation. It was taken for granted by those interested that oil deposits were subject to location under these laws. An act was passed in 1897 which cleared up any doubts that might have been existing at that time in regard to oil claims by declaring that oil territory could be located and patented as placers. In 1911 congress passed the "five claims act" which had special reference to oil locations. This act allowed annual labor to be done on one of a group of five contiguous claims for the benefit of the five claims.

During the administration of President Roosevelt when the conservation movement had gained considerable headway, after conference with representatives of the geological survey, he directed that organization to make an inquiry with a view of locating areas within the public domain believed to be rich in deposits of petroleum, having in mind its use as fuel for the navy since oil was becoming the main reliance of navies of the world as fuel. The survey was not completed during his term, but as a result of the inquiry made his successor, President Taft, in 1909 and 1910, issued orders withdrawing from all forms of entry the areas which are now known as the naval oil reserve lands.

Though these lands were thus withdrawn it was not until later they

were specifically set aside for the use of the navy. President Taft designated two areas in California as reserves in 1912, and President Wilson the third, in Wyoming, in 1915.

It was not intended at any time that the store of oil thus assured should be drawn for current use or for use at any time when the requirements of the navy could be met by purchase in the open market. The government contemplated the preservation of this supply for use only at some time in the more or less remote future when an adequate supply of oil could not be procurable at a reasonable cost.[30]

From the very beginning when these areas were set aside there has been a struggle between the government on one side and acquisitive interests on the other. Various and many reasons were set forth why they should be opened for development. This struggle came to a head in the litigation arising out of the leases on Tea Pot Dome and on naval reserves, numbers I and II in California. A great deal of scandal was exposed during the court trials. The last chapter of the affair was closed with the release of Harry Sinclair from jail and the acquittal of Edward L. Doheny for bribery.

In order to clarify the situation an act was passed by congress in February, 1920, authorizing the secretary of the interior, under rules and regulations that he may prescribe, to grant prospecting permits for oil and gas not to exceed a term of two years on tracts of not more than two thousand five hundred and sixty acres. These permits applied to lands owned by the United States not on known geological structures. The permittee was required to begin drilling operations within six months from the date of the permit and, within a year after the first date, drill one or more wells for oil and gas to a depth not less than five hundred feet, unless valuable deposits be found at a higher depth. Within two years from date of permit he was required to drill for oil or gas to an aggregate depth of not less than two thousand feet unless valuable deposits be found before reaching that depth.

Some of the other features of this act were: Title to mineral deposits named in this act could no longer be secured under patent, except such deposits as were included in valid locations exisiting at the date of the act; the right to produce such minerals could be secured only under permits and/or leases issued by the government, which such documents, in such instances, should reserve substantial royalties to the government; the acreage which an individual or corporation could operate, directly or indirectly, was limited; operations were required to be conducted under the supervision of the department of the interior; the state in which production of minerals should be secured was given a share of the royalty resulting from such production; and

30. Leases Upon Naval Oil Reserves, report No. 794, United States senate, sixty-eighth congress, first session.

consent was given to taxation of the property of producing agencies by the states.

There are two features in the lease drawn by the department of the interior under the authority of this act. Precaution is taken by the government to see that the lessee does not permit any physical waste of oil and gas to take place either in the drilling or in the operation of the well or wells. The second feature is rarely seen in leases on private lands. This provides that whenever the average daily production of any oil well shall not exceed ten barrels *per diem,* if in the judgment of the lessor the wells can not be operated successfully upon the royalties agreed on in the lease the amount of royalty shall be reduced. If this clause were incorporated in all commercial leases it would permit the operation of wells that otherwise would have to be abandoned and the recovery of more oil that otherwise would be lost. Wells that are below the margin at certain price levels could be restored to the margin and made economically productive.

Several amendments to this act have been passed for the purpose of extending the time during which the secretary of the interior for good cause shown may extend permits. The act has been amended in such manner as to limit the rights of claimants under it, in their holdings to an acreage basis.

This act has had considerable influence on the economic structure of the public land states. Millions of dollars have been spent in the exploration for oil. Industrial activities have been stimulated. Roads and bridges have been built. Camps and villages have been established. Oil machinery, tools, pipe, and other materials have been manufactured in or imported to those states. Refineries and pipelines were constructed. All this activity has increased the pay rolls. Property values have increased and the states have benefited from increased taxable values and tax collections. The division of the royalties by the government with the states benefited them materially. The total payments to the states from receipts under this act to June 30, 1929, amounted to $23,820,929.32. The largest share went to the state of Wyoming during this period with a total of $18,715,816.87.[31]

For several years the department of the interior extended its efforts to bring within the operation of the act as much of the public domain as possible in order to increase the royalties accruing to the government. Very shortly after President Hoover assumed his duties as president, having previously served on the federal oil conservation board through virtue of his being the secretary of commerce, he made this announcement on March 12, 1929:

31. Annual report of the secretary of the interior, 1929, p. 124.

There will be no leases or disposals of government oil lands no matter what category they lie in, of government holding or government controls except those which may be mandatory by congress. In other words, there will be complete conservation of government oil in this administration.

Conforming to President Hoover's policy of conservation of oil and gas resources Secretary Wilbur of the department of the interior on March 16, 1929, issued a departmental order appointing a committee of three to pass upon outstanding permits to prospect for oil and gas on government lands and to make recommendations as to which of those permits should be cancelled. The members of the committee appointed were: The commissioner of the general land office, the director of the geological survey, and the solicitor of the department. The order also laid down the general policy with relation to the permits to be followed by the department. The order as released to the press follows:

The federal oil conservation policy announced by President Hoover will be energetically executed by the interior department.

There are more than 5,000 applications for oil and gas permits on public lands pending in the general land office in Washington and an unknown number in the field offices. Steps were taken several days ago toward the rejection of all such applications, and registers of local land offices have been instructed not to receive new applications.

Probably in none of the cases on hand has the applicant expended money for developmental purposes, although he may have gone to some expense in opposing conflicting claims or furnishing additional evidence in support of his application.

Where land covered by pending applications is likely to be drained by adjoining wells on privately-owned lands, the question of granting permits on government land will be considered in the light of facts developed by departmental investigation.

With regard to the 20,000 outstanding permits on public lands, the department will deal fairly with holders who have been diligent in maintaining their equities. Where actual drilling operations have been started and are being continued, opportunity will be given to carry on developmental work to determine finally the character of the land. Immediate steps will be taken, however, to cancel all such permits where no drilling has been done or money spent in development.

To determine the facts in connection with existing oil and gas permits, I have named a committee consisting of the commissioner of the general land office, the director of the geological survey, and the solicitor for the department. They will consider the extent of operations which have been prosecuted under outstanding permits to determine whether permittees have acquired equities which should be recognized and to make appropriate recommendations.

Where permits are now in good standing, either because of recent issue or previous extension of time, no action will be taken during the remaining period covered by the permit. When that time has expired, however, and the permittee has failed to comply with the terms of his permit, he will be called upon immediately to show cause why the permit should not be cancelled. This includes so-called group developments heretofore approved and in which extensions have been allowed, where permittees are engaged in a joint drilling program, test wells being drilled by a responsible drilling company on some of the public lands in the area covered by the permits. So long as this program is being diligently prosecuted, no adverse action will be taken.

No leases will be issued for oil and gas production unless required by mandate of law, such as discovery under existing permits, as provided by the mineral leasing act, or through the advertisement of a minimum of 25,000 acres of Osage Indian lands annually, as directed by the act of congress, approved March 2, 1929.

Four days later, on March 20, 1929, the department issued an outline of the procedure to follow in carrying out its program of conservation. It is the policy of the present administration to set an example for the industry to follow. The United States government is the largest single owner of oil and gas lands. If a policy of conservation is to be carried out which will be beneficial both to the industry and to society in general the government must take the initiative and lead the way. According to this order representative cases may be recommended for public hearing before the secretary of the interior to determine lines of policy. Those not involving expenditure of money in development work will be denied by the general land office. The general land office will hold for cancellation, allowing fifteen days to show cause, all permits on which there is no *prima facie* evidence that expenditure of money in development work has been made. The geological survey will report to the secretary the likelihood of oil and gas drainage of government lands in various producing and wildcatting fields where claims of drainage are made.

Robert D. Hawley, general attorney for the Continental Oil Company, in an address before the Rocky Mountain Oil and Gas Association, November 20, 1929, at Casper, Wyoming, said:

The reasoning that the president's statement of policy was made more for the moral affect it would have upon other agencies involved, in an effort to curb overproduction, than for conservation of production from government lands, is borne out by an examination of the facts. There was no overproduction of oil from public lands. Figures available indicate that less than three per cent of the country's production was coming from lands operated under the leasing act. On March 1, 1929, there had been issued, under section 13 of the leasing act, 34,950 prospecting permits. Prior to that date, 14,690 of the permits had been cancelled. Only fifty-six leases had been issued in pursuance of all of the permits granted. Four hundred and eighty-nine leases had been approved under the so-called relief sections of the act, and these, together with the fifty-six leases issued under Section 13, made a total of 545 leases in existence by virtue of the leasing act on March 1, 1929. There probably was good reason for the government to join in a program of conservation in the state of California, but the Rocky mountain states were not producing enough oil to permit the operation of the refineries in those states at maximum capacity. On the other hand, the mountain states were the most seriously affected by the new policy as they were composed, in large degree, of public domain.

The reversal of the public land policy with special reference to oil exploration on public lands has met with a great deal of criticism from the interests affected in that area. Mr. Hawley, although he did not commit himself in his address, said that the argument against the policy of restricting leases on public lands were based upon the grounds that the leasing act was in effect a compact between the United States and the public land states,

as represented by their members in congress, intended to end their controversies and promote the mining of minerals mentioned in the act on the public domain. This compact, it is said, guaranteed to the public land states a portion of the royalties to be derived from such operations. It is urged that by virtue of such compact, the public land states became vested with the right to have the purpose of the act carried out and that an executive officer of the government is without power to disturb such rights. It was also urged, according to Mr. Hawley, that the intent of congress, in passing the act, was to encourage mining operations in an orderly manner, and that only congress could change the policy laid down in the act.

The government's side of the question involving oil conservation on public land is summarized very well in the annual report of Dr. Ray Lyman Wilbur, secretary of the interior. Dr. Wilbur said:[32]

Unsound exploitation of the public domain under oil prospecting permits has, in some cases, been shocking. Although the law allows two years within which very moderate drilling requirements may be met, and provides for extensions thereafter up to a possible total of nine years, an examination of the outstanding permits, occasioned by the president's conservation order, has so far disclosed that, up to November 15, 10,995 of these permits required cancellation for lack of diligence out of approximately 20,300 outstanding. They have been largely held for speculative purposes and some have been used as a basis of blue-sky operations. The ratio of these frozen permits to the total outstanding has amounted to about fifty per cent, representing *prima facie* noncompliance with the law to that extent. No permit which has been regarded as sufficiently valuable by its holder to justify compliance with the law has been affected by this order. The total area of active permits will probably not exceed 10,000,000 acres upon which genuine development is now in progress, as against 40,000,000 acres covered by permits before this house-cleaning was undertaken. The public domain is being rapidly cleared of these abuses. A method of review has been provided whereby all alleged equities under permits are considered by a departmental committee. Up to November 15, 1,512 cases had come before the committee and 1,282 of these had received favorable action. There are several thousand similar cases under review, awaiting decision. Very careful consideration will continue to be given to equities, particularly legitimate development and reliable geological investigations. That the cessation of issuance of prospecting permits has no immediate prospect of injuring the oil industry of any of the states affected is apparent when it is considered that in the seven major public land oil states of Wyoming, Utah, Idaho, Colorado, Montana, New Mexico, and California, the number of wells completed to production on public lands in all of 1928 and the first half of 1929 amounted to 249, where on March 12, 1929, the date of the conservation order, there were shut-in wells in those states totaling 4,115. The great disproportion of these figures is occasioned by the situation in California where new wells on the public lands for the year and a half ending July 1, totaled seventy-one wells, whereas the shut-in wells on all the lands of the state on March 12 totaled 3,560. But shut-in wells outnumbered new public land wells in every one of these states except New Mexico. In the absence of a need for production from new wells, as evidenced by these figures, further exploitation of the public domain at the present time means overproduction and consequent further wastage of an irreplaceable resource.

32. *Ibid.*, p. 10.

According to an Associated Press dispatch of April 10,[33] Secretary Wilbur's methods in carrying out President Hoover's policy in regard to public lands were disapproved April 9, by the supreme court of the District of Columbia. In a case brought by Richard O. Vedder of California and another by Roc C. Barton of New Mexico, Justice Jennings Bailey of this court held, in granting a mandamus against the secretary of the interior, that neither the president nor the secretary of the interior had the power to close entirely public lands to permits for drilling for oil and gas. Justice Bailey held that the granting of a permit request was discretionary with the department of the interior but that the discretion was not absolute. This decision has opened the question of exploiting government lands and it probably will not be settled until acted upon by the supreme court of the United States.

After having outlined in this chapter the basis on which oil and gas rights have been established in the United States and how these rights affect the problem of stabilization, it will be the purpose of the next chapter to show how production methods and costs through the exercise of these rights affect the problem.

33. *The Daily Oklahoman,* April 10, 1930

CHAPTER FIVE

THE PRODUCTION OF PETROLEUM

IT was shown in Chapter IV how the law protects the personal liberty of the individual to drill for oil when and where he pleases; how the law protects him in his property rights in respect to petroleum; and how individual initiative is stimulated through this protection afforded by the courts. It is on account of these basic principles of *laissez faire,* which the industry has defended so religiously and which the courts so generously have upheld, that the petroleum industry is in its present predicament.

In spite of these facts the improvement of technology plays no small part in the stabilization of the industry. The element of uncertainty has always been more prominent in the oil business than in any of the other basic industries. It is no less true today than it was seventy years ago that the only way to find oil is to drill for it. Science has reduced the uncertainty to a considerable extent by telling the operator where and where not, to drill. Science, however, does not guarantee its advice.

When the first oil was discovered, operators knew nothing of geology. They relied on "hunches" or had preconceived conclusions as to the occurrence and nature of petroleum. A number of erroneous popular beliefs about the occurrence of oil deserve particular mention. It is sometimes said that oil occurs below the surface of the ground in some regions just as water does in others. This would mean that a well in an oil region is as likely to strike petroleum as a well in a waterbearing region is likely to strike water—that the oil is distributed in an almost continuous sheet beneath extensive parts of the country. This is not true.

Another statement frequently heard is that the oil forms an underground "stream", and that a lucky location for a well must lie over that "stream". Expensive and fruitless drilling has repeatedly shown that such "streams" of oil do not exist. A belief that is held strongly in some parts of the country is that oil pools are connected—that a channel connects the pools in an oil region. This belief is disproved absolutely by the ranks of barren wells that encircle practically every producing oil pool in the world. Another erroneous idea is that petroleum occurs in underground ponds or lakes. In fact, prospectuses of some oil companies have referred to "lakes and rivers of oil," giving the idea of great caverns filled with oil. Not a cavern has been found in any of the oil fields in the United States. Oil is really contained in the tiny openings between grains of sand, in the pores and crevices of a crystalline limestone, or, as in the largest wells, in the comparatively small openings of a very porous rock.

Superstition and ignorance have contributed their part in the exploration for oil. Peach twigs and "doodle-bug" methods were relied on more than science. Geology was looked on in askance. Even today there are oil men of the old school who view the geologist with suspicion. The establishment of departments of geology within the organization of oil companies is something of comparatively recent date. The fear of famine during the war and immediately thereafter caused the oil men to rely on the geologist more than ever before. He has proved his worth in the years that have followed until today no producing company of importance attempts to get along without his services.

Service of Geology in Oil Production

Thirty years ago operators were not so skillful, and they were also quicker to believe that a pool had been drilled completely or an area condemned, than they are today. Also, and perhaps most important of all, they did not then have the advantage of the intensive application of geology to the discovery and development of oil that has contributed so much to the discovery of new pools, particularly in the Mid-Continent, Rocky Mountain, and California fields, during the past ten years. It may be predicted confidently that as new pools become scarcer and harder and more expensive to find, oil operators will call upon geologists more and more to study intensively the old pools, either those that have been abandoned or those that produced only small quantities of oil, and that the studies will result in the discovery of oil in territory that is now looked upon by most men as almost worthless.

In many fields two or more "booms" have followed the discovery either of new oil-bearing beds below the ones first developed or of an extension of the field in some direction where the dry holes that bordered the area that was originally productive were due to some local cementation or to a lack of porosity or some other condition in the oil sand and did not mark the true edge of the pool. The surprising thing is not that these discoveries are made but that they have led to so little drilling in search of new sands and of extensions of pools in fields where production started many years ago and that geologists so generally devote their time to a hunt for new producing areas and neglect so much the work that would lead to the complete development of the older fields.

The first method used by the geologist in his attempt to locate oil was through a study of the surface. Surveys were made, elevations were taken, in order to find the high point of the structure studied. This indicated an anticline. Since the earth's surface is in layers of different kinds of formations lying approximately parallel to each other, the position of the top formation would indicate the same position of lower formations. After surveys were made of the surface and wells put down, the information derived from the logs

of the wells assisted the geologist to make subsurface surveys of the particular area by correlating the data obtained from the logs. Operators, from the earliest times, have kept some kind of record of the formations found in their wells. These data were considered personal property. Many of them were crude and incoherent. As time went on these logs have become more complete. Practically all the oil producing states now require the operators to file well records with the proper constituted authorities. These records are a matter of public information and are published at regular intervals. Until about 1925 there was very little analysis of the formations drilled. Today accurate sampling, coring, chemical and geological laboratory studies have become established functions of the oil company's geology department. Paleontology has been taken out of the realms of the academic cloister and is being applied to practical purposes by petroleum prospectors. In this way science has assisted the industry by directing the operators to drill in the most favorable locations, thus eliminating the expense in putting down wells in a haphazard fashion with a greater percentage of dry holes.

The geologist does not claim to be infallible in judgment. He has often erred. Again, the indications may have been of the most favorable nature as far as surface structures are concerned but the subsurface structures did not run true to calculations which fact caused the operator to spend his money on a fruitless test.

One of the most important problems with which the producer has to deal is the development of his oil properties in such a manner as to realize the largest possible returns at a minimum cost. Promiscuous drilling is something no operator can afford. It is important both from a social and from a business viewpoint to know the extent of the oil bearing lands in the United States. The United States geological survey, the Oklahoma geological survey and the surveys of various states have been making a study of these resources for half a century. Federal authorities knew as far back as 1883 that there were oil and gas fields in Oklahoma and Texas, and perhaps in other portions of the Mid-Continent region, although the first oil production in Oklahoma was not found until June 25, 1901, when the first well was brought in at Red Fork between Tulsa and Sapulpa. In 1883 the department of the interior sent Colonel Bowers, well known geologist of his time, to the southwest to locate and sketch possible oil fields. Much of the work that his party did has aided materially oil companies today in the location of oil properties.

The business of finding oil involves so much expense that it is important to know exactly where to put down the well. Surface geology is important but inadequate in locating the deeper fields. After an area has been leased the larger companies employ the core drill to assist them in reducing the element of chance.

The geologist through the study of the cores taken by the diamond drill can determine the character and extent of the structure—the depth, porosity, thickness, gas content, saturation and water limit of the sand; and approximate the gas pressure and volume of oil output. With these facts, the producer is assured economical operation because he can drill wells so as to penetrate sands only to the most productive point; he can space wells so as to secure maximum production from each well; he can limit wells so as to conserve gas pressure and insure natural flow over the longest possible period; and he can space wells so as to increase the life of the well with consequent reduction in operating costs.

It is a frequent occurrence in the oil country for a company to go back with a core drill over an area that has been worked by surface methods and find considerable inaccuracy in the latter method. The experience of the Pure Oil Company and the Twin State Oil Company is not uncommon. These two companies had surveyed an area in Payne County, Oklahoma, by working the surface rocks. After locating the "high" by this method they drilled a well jointly which proved a failure. Thinking that some error had been made they worked the area again with surface methods and came to unsatisfactory conclusions. They then decided to test the area with a core drill and found they had been off the true "high" by a quarter of a mile. The second well they drilled was a success.[1]

Although the surveys of the federal government and the various states have done considerable work in the location of possible areas where petroleum is likely to be found, it is the oil operator who spends the money, whether it is his or some one else's, to locate oil definitely by actual drilling operations. Before undertaking this expense other scientific devices are employed. There is no way to estimate accurately how many millions of dollars the oil companies have spent in the exploration for new oil fields.

Applications of Geophysical Methods

The physicist has been called in by the geologist to assist him in his work. The physicist has contributed the torsion balance, seismograph, and the magnetometer to aid in the finding of oil. No device has been constructed yet that will locate definitely possible oil resources. However, these instruments have reduced greatly the element of chance and this fact alone justifies their use.

The geologist is primarily interested in locating uplifts. It was explained in a previous chapter that it is in these high places in the structure that oil and gas are more than likely to be found. Geologists often compare the shape of these formations to that of an inverted saucer. It was also mentioned in a previous chapter that the formations in which oil and gas are found lie under

1. J. L. Dwyer, "Core Drilling Discovers Many Pools," *The Oil and Gas Journal*, September 29, 1927, p. 56.

impervious rock. Frequently these structures lie so deeply beneath the surface of the earth that it is impossible to detect them without the aid of special instruments. The principal instruments used are the torsion balance which employs the principle of gravity; the seismograph, the principle that sound waves travel faster through dense rocks than through loose rocks; and the magnetometer, the principle that deep-seated hard rocks contain more magnetic material than softer rocks or less dense formations.

Geophysical methods were first used successfully in the location of salt domes on the Gulf coast. So marked was the success of these methods in this area that their use rapidly spread to other areas where they did not prove to be so successful. Geophysics as applied to the location of oil bearing sands is still in the experimental stage. As these devices are improved the more easily will it be for the operators to determine the extent of the oil bearing areas. Once this fact is determined the programs of drilling, proration, and unit development will be more easily carried out. Research in the development of geophysical instruments has gained more headway in Germany than it has in this country. However, ninety per cent of the work of the geophysical consulting companies of Germany is done in foreign countries.[2]

Dr. George Otis Smith, director of the United States geological survey, in testifying before the federal radio commission on November 13, 1928, emphasized the importance of geophysical methods in oil exploration especially as they influence the economics of oil production. Dr. Smith's testimony is quoted here in part:

> To me conservation of oil involves stabilization of an industry which since the beginning of its history in 1859 has suffered serious ups and downs. In planning that stabilization, no condition would be more effective than the assurance of adequate supply for at least a few years ahead. President Coolidge spoke of the necessity of drilling "many thousands of new wells each year" and the oil conservation board reported that "the annual production during many years has been sustained by the discovery of sufficient new fields each year to maintain a very large contribution from this flush flow. Therefore, supply equal to our present demands hangs definitely upon the rather precarious basis of repeated new and important discoveries." It is this uncertainty that introduces a big hazard into an industry upon which the public depends for an increasing proportion of its fuel. To reduce that hazard would be in the public interest.
>
> Related to the hazard of uncertainty in discovering new pools as needed is the loss in efficiency and economy incident to operating pools whose limits are not well determined in advance. The orderly operation of oil pools urged upon the operators by the federal oil board as a conservation measure of the first order of importance and now no less desired by the leaders in the oil industry is an economic ideal requiring a definite knowledge of the oil structure. The united and co-ordinated effort recommended by the government places upon the operating companies the burden of better engineering in advance of opening up a new field. The better economics in oil production asked in the interest of the public necessarily, then, involves the adoption of a new technique by the industry.

2. A. C. Heiland, "Development in Science of Geophysics," *The Oil and Gas Journal,* October 10, 1929, p. 186.

The oil pools that have yielded the ten billion barrels of our past production have been discovered in considerable part on geologic evidence afforded by surface indications. But more and more, as the production of these known fields declines, the hunt must be extended into areas where the surface rocks afford little or no clue of what lies beneath. Fortunately through the newly developed and scientifically applied methods of what has been termed geophysics the trained searcher for oil is now enabled to see far below the earth's surface and to detect and locate geologic structure favorable for oil accumulation. As always in the past, the drill is still the instrument that actually finds the oil, but the geophysical methods afford the means of making exploration by the drill far more effective and far more economical. Capital and labor are both conserved in finding oil by the use of these new methods. I believe such conservation of economic forces to be a matter of public interest.

The search for and blocking out of additional oil pools is plainly in the interest of oil conservation, because underground reserves of oil where nature stored it, once determined as to place and to approximate contents, would surely tend to stabilize the business of producing oil. Moreover, this storage of oil in the original package avoids the cost of storage in steel tanks and the risk of attack from the air, whether the destroyer be nature using lightning as a weapon or an enemy plane using bombs.

In attaining this desired end of establishing underground reserves by the producing companies, no agency promises more effective service than the geophysical methods of preliminary exploration. These methods are expensive to operate, but they save much of the money that would otherwise be wasted in drilling dry holes. For such geophysical exploration to be undertaken by the government's own scientific bureaus would involve expenditures far beyond the scale of present appropriations to the civil branches of the government. But any help that the government can extend to the private corporations that perform this public service would seem to be the best of public policy and directly in line with President Coolidge's instructions for the government to join forces with the oil industry in working out the problem of oil conservation.

The record of well completions in the United States show that the percentage of dry holes to wells producing oil and gas, or wells producing oil or gas, is increasing. The figures in Table IV show that the percentage of dry holes has increased from nineteen per cent in 1908 to thirty per cent in 1927. The Mid-Continent Oil and Gas Association has made a tabulation of the production of the initial or test well on each lease in Kansas and Oklahoma. According to their records sixty-five per cent of the initial wells drilled in 1928 came in dry. This was in increase of 8.6 per cent over the record for 1920. The figures of the Mid-Continent Oil and Gas Association for all the states east of the Rocky mountains reveal an increase in the percentage of dry holes from twenty-four per cent in 1920 to 32.7 per cent in 1928.[3]

According to *The Oil and Gas Journal*,[4] dry holes, abandoned wells and fishing jobs in the Greater Seminole area of Oklahoma have cost oil companies, individuals and drilling contractors operating in that area $10,581,200. One out of every six wells completed in that section—conceded to be the greatest light oil field ever discovered up to that time—has been dry while

3. American Petroleum Institute, *Petroleum—Facts and Figures*, 1929, pp. 98-99.
4. "Seminole Failures Cost $8,203,000," *The Oil and Gas Journal*, October 27, 1927, p. 33.

TABLE IV*

Wells drilled for oil and gas in the United States in 1859-1927

Year		Wells Completed		Dry Holes Total	Dry Holes Percentage
1859-1907	(a)	287,922	(a)	54,940	19
1908		16,909		3,214	19
1909		18,327		3,404	19
1910		14,940		2,422	16
1911		13,768		2,363	17
1912		17,180		2,855	17
1913		25,590		4,282	17
1914		23,137		4,142	18
1915		14,157		2,981	21
1916		24,619		4,039	16
1917		23,407		4,851	21
1918		25,687		5,613	22
1919		29,173		5,986	21
1920		33,911		7,364	22
1921		21,937		5,160	24
1922		24,689		5,332	22
1923		24,438		5,883	24
1924		21,888		5,044	23
1925		25,623		6,734	26
1926		29,319		7,965	27
1927		24,143		7,210	30
		740,764		151,784	20

(a)From Papers on the Conservation of Mineral Resources, United States Geological Survey Bulletin 394, 1909, pp. 30-50.

*Bureau of Mines, *Petroleum in 1927*, p. 577.

19.3 per cent of all the wells completed in the area were either dry or abandoned. Fishing jobs in the Seminole area, exclusive of the Little River pool, up to October 1, 1927 represented a cost of $2,378,200, while the time spent on these fishing jobs, totaled, exceeds thirty-two years. This would leave a balance of $8,203,000 to October 1, 1927, spent on wells that were a failure.

It would appear after a superficial investigation of data presented that scientific methods have been of little benefit to the industry in eliminating the tremendous expense incurred in drilling dry holes. The question might be inverted, what would the percentage have been with its attending cost had the industry not used these methods? It is impossible to estimate the savings. There is no way of finding out, since the companies engaged in the business have no records. Evidently scientific methods pay because oil producers are spending more and more money every year in these channels.

The Wildcatter and His Influence

A very large per cent of these dry holes were drilled by wildcatters.[5] The percentage in proven areas is much lower. There is no class of individuals

5. A wildcatter is a person, individual or corporate, who undertakes to explore for oil in unproven territory. The term is almost as old as the industry itself and is as respectable as the most scientific usage in the oil industry's terminology. It had its origin in the early days in Pennsylvania. When the drillers and other oil field workers came to town, on being asked where they had been, replied that they had been up the creek with the wildcats. This term has been universally applied to those engaged in drilling for oil in virgin territory.

anywhere so imbued with the spirit of optimism as the wildcatter. He can always see success just ahead of him. The end of the rainbow is at the bottom of the next well. Their enthusiasm is frequently contagious and they succeed in persuading others to risk their money with them. In fact, some of them are so full of enthusiasm that they can persuade others to risk all the money. There is always a sufficient number of the successful wildcatters to fan the flame of hope. Their ostentation is always in evidence. The failures are soon forgotten. If they are wiped out completely there are always others with new hope ready to take their places.

The institution of property rights, as explained in a previous chapter, is responsible for this type of operator. He is often blamed for the plight in which the industry finds itself in the recurring periods of overproduction. However, the wildcatter is not entitled to all censure. He is deserving of commendation as well. Through his energy, initiative, and optimism the world has not wanted for petroleum. He is responsible for fields that probably never would have been discovered without him—for this he has been blamed. The critics of the industry maintain that society could have gotten along without them for years to come. To some extent this is true. However, it is not the discovery of the fields that has wrought the damage. It is the unrestrained production that has done the harm. The very presence and knowledge of these resources have kept the price of petroleum and its products within reasonable bounds. Had these resources been unknown, or known to only a few, the prices would have been so high that the same critics would have spent their energy carping about the high prices of petroleum products or spreading the fear of famine.

There have been 59,139 dry holes drilled in the United States east of the Rocky Mountains in the period 1920 to 1928, inclusive. Allowing $10,000 per hole, and this is a most conservative estimate, $591,390,000 have been spent in unproductive effort in the industry in the space of nine years.[6] Although this sum is a social cost it has not all been borne by the industry. A good part of the investment in dry holes has been contributed by outsiders. The per cent of outside investors in wildcat properties was larger from 1920 through 1925 than it has been since that date. It costs more to drill wells today because the prospector must drill deeper, therefore, much of the prospecting like that going on now in the Oklahoma City area is by companies well financed to undertake the enterprise.

The average gross cost of drilling dry holes in the United States in the year 1928, estimated by the American Petroleum Institute, was $165,799,000. The estimate for the period 1920-1928 in the preceding paragraph is, therefore, shown to be extremely conservative. At no time during this period was the

6. American Petroleum Institute, *op. cit.*, p. 98.

average cost in Oklahoma less than $23,000. The American Petroleum Institute's estimate of dry hole costs for the United States in the year 1928 is shown in Table V.

TABLE V

Estimated Cost of Drilling Dry Holes in the United States in 1928.*

District	*Number of Dry Holes*	*Estimated Cost the Well*	*Estimated Cost of Drilling*
Oklahoma	1,227	$45,000	$ 55,215,000
Kansas	455	25,000	11,375,000
North Central Texas	1,810	10,000	18,100,000
East Central Texas	101	19,000	1,919,000
West Texas	307	35,000	10,745,000
Panhandle of Texas	89	40,000	3,560,000
Southwest Texas	311	20,000	6,220,000
Gulf Coast	628	28,000	17,584,000
North Louisiana	235	24,000	5,640,000
Arkansas	178	15,000	2,670,000
New Mexico	45	60,000	2,700,000
Wyoming	65	35,000	2,275,000
Montana	120	15,000	1,800,000
Utah	7	50,000	350,000
Colorado	70	50,000	3,500,000
California	191	90,000	17,190,000
Eastern Fields	1,239	4,000	4,956,000
TOTAL	7,078	$23,425	$165,799,000

*Well completion figures from *The Oil and Gas Journal*. Costs estimated by American Petroleum Institute. *Petroleum—Facts and Figures*. 1929, p. 118.

The tremendous cost expended in the production of oil is a burden that must be borne by those who make the expenditure. It cannot be shifted to the consumer of petroleum products. The reason for this will be explained in the next chapter.

Sometimes the risk of wildcatting is borne on a co-operative basis by those interested in the properties involved. A wildcatter will block a large acreage and sell off interests to others with the understanding that a well will be drilled in a certain location to a certain depth. If the well comes in dry the area has to some extent been proved worthless. If the well is a producer then those who have purchased interests are "sitting in" with good leases near the discovery wells.

Frequently an operator in wildcat territory is able to persuade adjacent property holders to contribute "dry hole money." It is cheaper for a group to test an area on a co-operative basis than for each one to undertake it by himself. The operator persuades the holders of the adjoining leases to contribute toward the expense of drilling the well. If the well comes in dry their territory has been proved at a less cost than if they had drilled the properties themselves to find out. If the well comes in a producer, according to the usual terms of the agreement, the contributors of dry hole money are released from this obligation because the operator can be reimbursed from his own properties. Many large companies have assisted operators to prove wildcat territory. It

is more economical to contribute "dry hole money" than to undertake the entire expense of drilling a well. Recently the larger companies have refrained from making contributions of this sort in the interest of conservation. Too much oil has been on the market. To assist in carrying out the proration schemes in operation in most of the major fields all plans that would result in increased production have been abandoned except in those places where drilling is necessary to protect one's own rights. It would be entirely inconsistent for a company to urge proration of production in a highly productive area and contribute "dry hole money" to others to bring in a new area that has no economic justification.

Improvement in Technique

Not only has the science of oil exploration been put on a more scientific basis, thus eliminating to a more or less degree the element of chance and to this extent aiding in the stabilization of the business, but improvements in the technique of drilling and extraction of oil and gas are contributing their part. The industry will have taken a forward step towards conservation when it will have eliminated waste through reduced cost, through increased recovery at the same cost, or through increasing the cost so as to obtain a greater proportion of recovery. Engineers engaged in this branch of the profession are devoting a great deal of time and thought to this phase of the question. Such organizations as the bureau of mines, United States geological survey, American Institute of Mining and Metallurgical Engineers, American Petroleum Institute, American Association of Petroleum Geologists, Mid-Continent Oil and Gas Association, and others are giving a great deal of attention to the subject. Through the papers read before these societies, through publication of their proceedings and scientific reports much information is being interchanged that is working for the good of the industry.

It is the concensus of opinion among petroleum engineers that there is more oil left in the sands than is taken out. According to J. O. Lewis, formerly with the bureau of mines,

> opinions on the amount of oil left underground have ranged from twenty-five to ninety per cent, the commonest estimate being about fifty per cent. Precise data have never been submitted with any of the estimates, they being frankly generalities based on the judgments and experiences of the estimators. Some of the estimates are as follows: White, twenty-five per cent for oil sands of West Virginia; Arnold and Garfias, forty to sixty per cent for the oil sands of California; Ashburner, ninety per cent for the oil sands of Pennsylvania; Dunn, twenty-five to eighty-five per cent; Naramore, ninety per cent; Washburne, thirty-six to sixty per cent.[7]

The problem of extracting the oil from the sands is a very complicated one because of their varying characteristics. Dr. W. P. Haseman, formerly

7. J. O. Lewis, *Methods of Increasing the Recovery from Oil Sands,* Bulletin 148, Bureau of Mines, 1917, p. 25.

physicist for the Marland Oil Company, very lucidly describes the nature of underground oil reservoirs in the following paragraph:

> An unexplored oil field is essentially a defined underground reservoir consisting of a porous formation and containing a fluid mixture of hydro-carbon liquids, vapors, and gases under certain conditions. The reservoir left intact contains the fluids either as a liquid with the vapors and gases held in solution by pressure or as a homogeneous or mixture of the liquids, vapors and gases under pressure and with varying chemical and physical properties. The fluids are confined and held under pressure, with the gases often segregated largely in the structurally high part of the reservoir. The porous formation inside the reservoir is made up of discrete particles of quartz and limestone, or other materials, which are irregular in size and shape, and more or less tightly cemented with varying materials. As a result the pore openings are also very irregular in size and shape, and form winding channels through which the fluid mixture must pass.[8]

The porosity of sand is a matter of high importance in the recovery of oil. As far back as 1898 Dr. C. S. Slichter showed that the porosity of sand composed of spherical grains of uniform size is independent of the size of the grains and is dependent exclusively upon the arrangement of the grains. He proved by mathematical methods that, for spherical grains of uniform size, the porosity is 47.6 per cent for the least compact arrangement and twenty-five per cent for the most compact. Intermediate conditions between these two extremes are estimated between twenty-six and forty-eight per cent.[9] Since oil sands are not generally composed of spherical grains of uniform size, their porosity is frequently much less than twenty-five per cent.

The study of oil production methods by the bureau of mines and by private agencies in regard to the amount of oil originally present in oil-bearing formations reveal that in most cases the total production of a field is dependent upon the available gas rather than upon the available oil. When the gas in the sand is exhausted oil production is stopped regardless of the amount of oil left in the reservoir. It is, therefore, highly important that the gas be conserved to the most economical use. According to the bureau of mines, studies of oil and gas ratios have indicated that much of the available gas has been wasted as far as its effectiveness on oil production is concerned.[10]

Efforts at Oil Conservation

Under our present system of property rights and individual initiative it is very difficult to enforce any kind of conservation program unless it can be proved that money can be made by it. Conservation, in the abstract, may have a wide academic appeal but not in the ordinary courses of economic activity, except where it is evident that a profit can be realized. The pressure is too great in the present economic set-up. Bills and dividends must be paid.

8. W. P. Haseman, "Value of Gas in Petroleum Production," *The Oil and Gas Journal*, December 8, 1927, p. 96.
9. C. S. Slichter, "Theoretical Investigation of the Motion of Ground Waters," United States Geological Survey, nineteenth annual report, 1898, Part 2.
10. Bureau of Mines, Serial No. 2732, 1926, Introduction.

Oil has no value until it is brought to the surface. Unlike oil, gas is valuable under the surface and above it. Its chief value lies in its ability to propel the oil to the top of the ground. If oil companies in their cost accounting would take into consideration the value of the gas, compressed by natural forces and found with oil, its value would be increased greatly.

Most of the producers are lending their best efforts today to the greater utilization of natural gas in the production of oil. There are always some in any proposed co-operative plan who hold back. It is, therefore, necessary for the state to bring into being laws to protect the best interests of the group. Oklahoma, Texas, California and some of the other oil producing states have legislation regulating the use of natural gas.

The Lyon gas conservation law of California that went into effect September 1, 1929, is the most recent legislation dealing with the subject. R. D. Bush, state oil and gas supervisor, is quoted in The *New York Times*[11] regarding the procedure under the law.

> It is my duty to ask the state director of natural resources either to order a hearing before me as supervisor or bring action in the superior court for an injunction restraining unreasonable waste of natural gas whenever I find that natural gas is being blown, released or allowed to escape into the air and the person responsible makes no showing of necessity to take his particular case out of the statutory presumption.
>
> The following is a proposed plan for disposition of natural gas in the Los Angeles basin and Ventura fields:
>
> First, that the amount of gas sold to the gas companies shall be taken *pro rata* from all the producers but that the companies having the contracts shall receive the payment for such gas in accordance with the terms of their contracts as though their own gas had been delivered thereunder.
>
> Second, that all gas used in the field for fuel or other operative purposes shall be taken *pro rata* from all the operators in that field.
>
> Third, that all gas used for repressuring in the field from which the gas is produced shall be taken *pro rata* from all the operators in said field who shall contribute *pro rata* to the cost of injection of the gas.
>
> Fourth, arrangements are being attempted for removing gas from fields and storing the same in distant reservoirs. If this can be worked out, it is understood that type gas so stored will be taken *pro rata* from the producers and without charge to the producers for injection or transportation. This gas, when recaptured, will belong to the operators contributing toward the cost of injection subject to such arrangements as can be made with the owner of the reservoir.
>
> Fifth, whenever *pro rata* is used in this plan it is to be understood that it is the proportion which the producers' maximum oil and gas ratio to be hereafter established bears to the total maximum production of the field under the same limitations.

The effects of this law is being watched with a great deal of apprehension by the producing interests. One of the difficulties in the way of its enforcement is the pro-rating of pipeline capacities. Another thing, numerous exhausted wells have been leased by operating companies with the intention of

11. The *New York Times*, September 1, 1929.

using these wells for the storage of excess gas produced by well drilling operations. According to statements in the press, the law is also described as being confiscatory and, therefore, unconstitutional.

There has not been sufficient time to make a full appraisal of the results of this law. Before it was passed much progress had been made in gas conservation in California but, at that, only forty-five per cent of the total surplus was being conserved in 1928.[12]

According to Dr. George Otis Smith, director of the United States geological survey, one billion cubic feet of gas a day were being utilized the latter part of 1927, and as many were being blown into the air as were being used.[13] The importance of this law is readily seen.

The federal oil conservation board in February asked congress for a small increase in appropriation for the fiscal year ending June 30, 1930. One of the things included in its program for next year is to try to bring about an enactment of uniform laws, or as nearly uniform as possible, for the conservation of oil and gas through state legislation with the board co-operating and waging an educational campaign.

According to Professor H. C. George,[14] director of the school of petroleum engineering of the University of Oklahoma, some interesting conclusions are made from results secured by Professors Wilbur F. Cloud and William Schriever in connection with the American Petroleum Institute project, number 33. They find that since the decrease in flow from an oil sand to a well is due to an escape of gas from the oil in excess of the gas-oil ratio and the obstruction resulting from the presence of this gas in the form of bubbles in the sand near the well opening, caused by the excess gas coming out of solution with the decrease in pressure as the oil approaches the well, why not in new fields try the experiment of operating all wells with no well producing at less than the initial rock pressure. Professor George illustrated the theory as follows:

> Let us take a hypothetical case. Suppose you have a small closed structure with an initial rock pressure of say three hundred pounds to a square inch. Assume that all wells are completed before any are produced. Build up a differential pressure above the initial rock pressure by compressing gas or air and introduce this compressed gas into key wells and at the producing wells maintain a back pressure on the sand equivalent to the initial rock pressure. The building up of this differential at the key wells should cause the oil to move towards the producing wells with none of the gas coming out of solution within the sand, and we should have the same condition of flow as when dead oil or oil free from gas is flowing through a sand.

Operators use both natural and artificial methods in obtaining the maximum ultimate recovery of oil. Ultimate recovery is the total amount of oil

12. R. D. Bush, *Petroleum World*, Los Angeles, Vol. 13, October, 1928, p. 82.
13. George Otis Smith, "Gas Conservation Sorely Needed in California," *The Oil and Gas Journal*, February 20, 1930, p. 46.
14. H. C. George, "Possible Method of Conservation of Oil and Gas," annual meeting of the American Institute of Metallurgical Engineers, New York, February, 1930.

which may be recovered economically from the well. When considered with respect to a lease or pool, it is the total amount of oil that can be recovered economically from the area or unit under consideration. The forces of nature which may be utilized are gas pressure, water pressure, gravity, and a combination of these.

The greatest improvements in the artificial methods of oil recovery have been made in the decade since the war. The artificial methods that have been most generally employed are the air-gas lift, controlled pressure operation, repressuring by air, or gas, or both, and the artificial water drive. None of the artificial methods is very effective where the surface rights are cut into small holdings unless there is co-operation among them. The air and gas will pass through an open channel to the neighboring property and unless his well can be controlled, the waste of pressure makes operation prohibitive. Leases of ten, twenty, and forty acres are too small for independent operation. It is important that the pool be operated as a unit to obtain the maximum results.[15]

Proper Spacing of Wells

The problem of proper spacing of wells is an important one both from an engineering and an economic viewpoint. Each pool is a problem in itself because of the differences in gas pressure, initial production, character of the oil, depth of the productive sand, character of the sand, thickness of the sand, and geologic structure. The principal economic considerations are distance from the market, cost of development, cost of operation, interest on invested capital, the price of crude oil and gas.

The present system of property rights, in actual practice, is the most potent factor in determining how many wells shall be drilled in a given area. Operators are required to drill offset wells. The greater the number of property interests involved the greater the number of wells that will have to be drilled. In the Oklahoma City field which has been producing for little more than a year the first well was drilled on a forty acre location. The acreage in this field is controlled by a few large companies. For a short time after the discovery well locations were made with one well to each forty acres. It was not long, however, until competition increased, until the locations today are one well to each ten acres. Production has been moving toward the corporate limits of the city where much of the land has been cut up into town lots. The larger companies interested in this field have been endeavoring to persuade the town lot owners to consolidate their holdings into community interests thus eliminating excessive drilling. They have not been successful in consolidating all these interests. At the present time wells are being drilled on locations considerably smaller in area. The Long Beach, California, pool is the most classic example of close order drilling.

15. J. O. Lewis, "Methods of Recovering More Oil from Depleted Fields," *National Petroleum News,* February 24, 1926, p. 81.

Not only is the extent to which surface rights are divided a factor in well spacing but custom has come in as an important influence. In several fields the operators have grown accustomed to space the wells one to each ten acres. As these operators extend their activities into other areas they follow the methods they were accustomed to in the older fields and with little thought space the wells in the new fields the same way.

A review of the literature by engineers on the problem of well spacing reveals the fact that no definite rule can be laid down how far apart wells should be put down in any given area. There are too many variable factors involved. Several scientists and engineers have worked out mathematical formulae to assist in the solution of the problem. In his work on the theoretical "Investigation of Motion of Ground Waters",[16] Dr. C. S. Slichter worked out formulae which have been the basis on which others have constructed theirs. According to Professor Lester C. Uren, professor of petroleum engineering in the University of California, efforts based on the mathematical method of approach are futile.[17]

A superficial glance at the problem might lead one to the conclusion, assuming that there is no interference of property rights, that, the fewer the number of wells, the better. Some confusion in thinking is due to the fact that production per well is confused with production per acre. Fewer wells on a given area throughout the life time of production may produce more oil per well and produce less oil per acre. In a study made by Dr. W. P. Haseman[18] based upon data recorded in a paper by W. W. Cutler, jr., and Walter S. Clute on "Relation of Drilling Campaign to Income from Oil Properties," Reports of Investigations, Serial No. 2,270, August, 1921, bureau of mines, the fact is brought out that there is a greater ultimate production from wells spaced three acres to the well than when the wells were spaced fifteen acres to the well in the Bartlesville-Dewey district in Oklahoma. Table VI shows the ultimate production and the computed ultimate production at various spacing in acres to a well.

TABLE VI*

Acreage spacing of wells, Bartlesville-Dewey district.

Spacing in acres to a well	*Actual ultimate production of an acre*	*Computed ultimate production of an acre*
15	987	994
10	1,420	1,420
7	2,000	1,903
5	2,260	2,410
3	3,250	3,275

*W. P. Haseman, *op. cit.*, p. 321.

16. C. S. Slichter, *op. cit.*
17. Lester C. Uren, "Principles of Oil Field Development," article III, *National Petroleum News,* January 1, 1930, p. 49.
18. W. P. Haseman, "Profits and Proper Spacing of Wells," *The Oil and Gas Journal,* October 11, 1928, p. 53.

Cost of Drilling

The petroleum business, like any other business in America today, is dependent upon profits. There is little likelihood that this system will be changed in the immediate future. Irrespective of what one's feelings may be toward this system, a problem of this kind, the stabilization of the petroleum industry, must be studied with the profit motive kept in mind constantly. Also, it must be kept in mind that increased profits and increased production do not always go together.

In Table VII, taken from Doctor Haseman's study, it is shown that profits are not only dependent upon physical production but on the cost of drilling wells and the price of oil. Doctor Haseman has made the following conclusions that the net profit to an acre varies:

1. With spacing of wells for a given well cost and net price of a barrel of oil.
2. With net price of a barrel of oil for a given well cost and spacing of wells.
3. With development cost for a given spacing and net price of a barrel of oil.
4. Attains a maximum value for some specified spacing of wells on a curve of given well cost and net price of a barrel of oil.
5. For a given well cost on the curve of $1 net price the barrel of oil may be as great as or greater than the net profit for the same well cost on the curve of $2 net price the barrel of oil at a wider spacing of wells.

TABLE VII

Estimated Profits in Relation to Well-Spacing in the Bartlesville-Dewey Area of Oklahoma.*

Property No.	*No. Acres to the Well*	*Net price the Barrel*	*To Producer Discounted net on oil per Acre*	*Net Profit an acre with Well Cost $2,500*	*Well Cost $5,000*	*Well Cost $10,000*	*Well Cost $20,000*
1.	15	$0.50	$ 343	$ 177	$ 10	$ 323	$ 990
		1.00	686	520	353	20	647
		1.50	1,029	863	696	363	304
		2.00	1,372	1,206	1,039	706	39
2.	10	0.50	544	294	44	456	1,456
		1.00	1,088	838	588	88	912
		1.50	1,632	1,382	1,132	632	368
		2.00	2,176	1,926	1,676	1,176	176
3.	7	0.50	760	403	46	668	2,097
		1.00	1,520	1,163	806	92	1,337
		1.50	2,280	1,923	1,566	852	577
		2.00	3,040	2,683	2,326	1,612	183
4.	5	0.50	867	367	133	1,133	3,133
		1.00	1,734	1,234	734	266	2,266
		1.50	2,601	2,101	1,601	601	1,399
		2.00	3,468	2,968	2,468	1,468	532
5.	3	0.50	1,248	415	418	2,085	5,418
		1.00	2,496	1,663	830	837	4,170
		1.50	3,744	2,911	2,078	411	2,922
		2.00	4,992	4,159	3,326	1,659	1,674

*W. P. Haseman, *op. cit.* p. 321.

The method of arriving at the figures is as follows: The actual ultimate production an acre as given in Table VI is taken. Computations are made with oil priced at $0.50, $1.00, $1.50, and $2.00 a barrel. Four estimates of

drilling costs were used: $2,500, $5,000, $10,000, and $20,000. Computations made in regard to Property No. 3 are shown as follows:

1. Gross production to an acre, barrels	2,000
2. Net production to an acre to producer, barrels	1,750
3. Net price to a barrel—assumed price schedule; (a) $0.50, (b) $1.00 (c) $1.50, (d) $2.00.	
4. Net on oil to producer at net price to a barrel of:	
(a) $0.50	$ 875
(b) $1.00	1,750
(c) $1.50	2,625
(d) $2.00	3,500
5. Discounted net on oil to an acre to producer (deferred returns) at net price the barrel of:	
(a) $0.50	$ 760
(b) $1.00	1,520
(c) $1.50	2,280
(d) $2.00	3,040
6. Development costs of an acre for well cost-assumed schedule of:	
(a) $ 2,500	$357
(b) 5,000	714
(c) 10,000	1,428
(d) 20,000	2,857
7. Net profit the acre to producer on:	
1. $0.50 net price the barrel of oil	
(a) $760—$357	$403
(b) $760— 714	46
(c) $760—1,428	—668
(d) $760—2,857	—2,097
2. $1.00 net price the barrel of oil	
(a) $1,520—$357	$1,163
(b) 1,520— 714	806
(c) 1,520—1,428	92
(d) 1,520—2,857	—1,337
3. $1.50 net price the barrel of oil	
(a) $2,280—$357	$1,923
(b) 2,280— 714	1,566
(c) 2,280—1,428	852
(d) 2,280—2,857	—577
4. $2.00 net price the barrel of oil	
(a) $3,040—$357	$2,683
(b) 3,040— 714	2,326
(c) 3,040—1,428	1,612
(d) 3,040—2,857	183

The same method was used in arriving at the figures on the other four properties.

Similar conclusions in regard to production were arrived at by Dwight

C. Roberts and Stender Sweeney[19] from their study of well spacing in the Long Beach, California, field. This field is different in character both in geology and in depth from the Bartlesville-Dewey field in Oklahoma. The sand in the former is much thicker than the sand in the latter. The Long Beach field has a shallow and deep zone. The investigators found that more oil was recovered by close drilling at both depths. This field has been as intensely developed as any field in the world. Derricks cover the area like spikes on a porcupine, the result of intense town-lot development. The age of this field is about six years. Areas of different sizes and shapes were taken for purposes of study from widely separated parts of the field. The recovery to an acre in wider spaced areas was less than that in the narrower ones of those studied. The conclusion of the authors is that a greater yield of oil will be obtained from an area closely drilled than from a similar one with wide spacing.

In a previous chapter it was shown that the present institution of property rights makes it necessary for producers to obtain the greatest possible production in a minimum time and at a minimum expense. The purpose of scientific well spacing, as it is practiced today, is to do the same thing. This is the reason for the present chaotic condition in the industry.

Scientific well spacing need not interrupt, however, a program of stabilization. It is in the interest of conservation to get the greatest yield at a minimum expense. Since the price of crude oil is one of the factors entering into the problem of well spacing and since the price of crude oil is influenced by the supply on the market it is, therefore, necessary to have effective control of production. To have effective control of production the pool must be the unit instead of the lease. Plans for unit control will be discussed in a subsequent chapter.

The total cost of drilling a well has increased with the passing years. In the early days of oil development in northeastern Oklahoma $5,000 was sufficient to meet the costs of putting down a hole. In the days when the shallow fields were being brought in, the costs were small and it was comparatively easy for independent operators to raise sufficient capital to put down a well. It is different today. A few years ago a 3,000-foot well was considered a deep well. Today a 3,000-foot well is considered shallow. It is more difficult for small operators to raise the money, consequently, production is being carried on now by the wealthier. Although there are a few individuals with sufficient capital who are operating as individuals most of the drilling is being done by corporations. The small producer has been pushed out and today instead of drilling wells he is buying and selling leases and royalties.

An idea how the cost of drilling in the United States has increased since

19. Dwight C. Roberts and Stender Sweeney, "Spacing of Wells in Long Beach Field," Paper read before the American Institute of Mining and Metallurgical Engineers, Tulsa, Oklahoma. October, 1930. *The Oil and Gas Journal*, October 10, 1929, p. 138.

1913 may be obtained from Table VIII. According to operators in the Oklahoma City field it costs from $100,000, to $150,000 to drill a well. The wells in this pool average around 6,500 feet in depth.

TABLE VIII

Cost of Drilling Wells in the United States Completed in First Ten Months of 1927 and 1913*(a)

	First Ten Months	*Wells Completed*	*Cost of Drilling*	*Average Cost to a Well*
Oklahoma	1927	3,844	$124,161,200	$32,300
	1913	7,433	34,689,811	4,667
Difference		3,589	89,471,389	27,633
California	1927	1,043	58,720,900	56,300
	1913	727	29,717,368	38,494
Difference		316	29,003,532	17,806
Kansas	1927	1,148	28,413,000	24,750
	1913	1,571	3,220,550	2,050
Difference		423	25,192,450	22,700
North Central Texas	1927	3,204	27,618,480	8,620
	1913	613	3,095,060	5,050
Difference		2,591	24,523,420	3,570
Gulf Coast	1927	888	24,420,000	27,500
	1913	633	1,867,350	2,950
Difference		255	22,552,650	24,550
North Louisiana	1927	599	6,664,890	11,110
	1913	428	2,354,000	5,500
Difference		171	4,310,890	5,610
Wyoming	1927	306	7,038,000	23,000
	1913	78	624,000	8,000
Difference		228	6,414,000	15,000
Colorado	1927	98	3,577,000	36,500
	1913	21	115,500	5,500
Difference		77	3,461,500	31,000
Eastern Fields	1927	4,016	20,288,414	5,409
	1913	8,007	21,266,592	2,656
Difference		3,991	978,178	2,853
Illinois	1927	131	720,500	5,500
	1913	1,419	6,385,500	4,500
Difference		1,288	5,665,000	1,000
Lima	1927	431	1,293,000	3,000
	1913	1,280	2,496,000	1,950
Difference		859	1,273,000	1,050
Central Ohio	1927	352	2,719,200	7,725
	1913	365	2,217,375	6,075
Difference		13	501,825	1,650

Kentucky-Tennessee	1927	1,044	2,610,000	2,500
	1913	211	390,350	1,850
Difference		833	2,219,650	650
Scattering	1927	11	275,000	25,000
	1913	15	210,000	14,000
Difference		4	65,000	11,000
East Central Texas	1927	74	2,960,000	40,000
West Texas	1927	752	16,130,400	21,450
Panhandle of Texas	1927	739	29,560,000	40,000
Southwest Texas	1927	743	14,860,000	20,000
Arkansas	1927	310	3,225,000	10,500
Montana	1927	429	4,942,080	11,520
New Mexico	1927	96	1,557,600	16,225
Michigan	1927	250	2,250,000	9,000
Total first ten months	1927	20,508	$384,004,664	$18,725
Total first ten months	1913	22,801	108,649,456	4,765
Difference		2,293	$275,355,208	$13,960

*In some of the divisions no drilling is shown in 1913. Either there was none, or the wells are included in the line carried as scattering. The few scattering wells in 1927 were drilled in the South Atlantic states.

(a) *The Oil and Gas Journal* "The Oil Industry's Answer Today," p. 44.

Although the drilling expenses have increased considerably that does not imply that the costs per barrel of all oil produced have likewise increased. The deeper wells produce more oil than the shallow ones. Table IX shows that while the number of wells completed since 1916 by years have decreased the initial production per well has increased.

TABLE IX

Daily Average Initial Production of Oil Wells Completed*

Year	*Oil Wells Completed*	*Daily Average Initial Production (Barrels)*	*Initial Production the Well (Barrels)*
1916	18,777	1,601,170	85
1917	16,590	1,511,028	91
1918	17,845	1,613,813	90
1919	21,052	3,554,486	168
1920	24,273	3,508,100	145
1921	14,666	2,827,809	193
1922	17,333	4,226,119	244
1923	16,206	6,105,100	377
1924	14,587	3,255,491	223
1925	16,559	4,300,356	260
1926	19,013	3,683,787	194
1927	14,442	4,918,456	341
1928	12,526	8,365,778	668

*American Petroleum Institute, *Petroleum—Facts and Figures,* 1929, p. 97. Data taken from United States bureau of mines.

The problem of stabilization in so far as it is affected by the production of petroleum lies in the fields with flush production. According to the American Petroleum Institute less than two per cent of the total number of producing oil wells in the United States are actually producing fifty per cent of the total oil.[20] According to the American Petroleum Institute there were 316,073

20. American Petroleum Institute, *op. cit.,* p. 93.

wells in March, 1929 producing on an average daily 2,657,801 barrels of oil. This is a daily average production to a well of only eight barrels. Over fifty per cent of this production was attributed to 6,024 wells, having a daily average production each of 232 barrels.

There is very little relationship between the number of wells drilled and the business cycle. This does not conform to current opinion, but statistics confirms the statement. Data for the number of wells drilled by months from January, 1922 through December, 1929, were taken from the reports of the Standard Statistics Company and compared with the general business curve of the American Telephone and Telegraph Company. Seasonal influences and the secular trend were eliminated. The two series were correlated, using the Pearsonian method, and the resulting coefficient was found to be .271 which indicates there is very little relationship. Allowing for the lags there was found to be even a less degree of relationship.

The number of wells drilled is considered a better index of activity within the industry than production records because there is no direct relationship between the number of wells drilled and the quantity of oil produced. A few wells like those in the Oklahoma City field may produce large quantities of oil and again in other places a large number of dry holes may be drilled before production is obtained. In spite of the movement of the business cycle drilling activity goes on because the owner of the oil and gas rights must drill to protect his property. For data see Appendix Table III.

The chief contributing factor to stabilization in any industry is certainty. Where there is no certainty conditions are unstable. Settled production is not a problem in the petroleum industry. The fields with flush production are the disturbing factors. Those charged with the study of the problem have centered their attention on these areas and it is there where the methods of control must be applied.

A study of stabilization is not complete without a study of price. The stabilization of the petroleum industry means also the stabilization of the price of petroleum and its products. The next chapter will be devoted to a discussion of the factors determining the price of crude oil.

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CHAPTER SIX

PETROLEUM—DEMAND, SUPPLY AND PRICE

MOST of the crude oil produced in the United States is refined. However, the refineries do not limit their source of supply to domestic production. The large refineries on the east coast are big consumers of Mexican and South American oils. In 1928 the refineries of this country used over 79,700,000 barrels of foreign crude oil and in 1929, 75,517,000 barrels were run through domestic refineries. This oil is in direct competition with domestic production and has considerable influence on the price making forces of the crude product.

Since there are so many more producers of petroleum than refiners, it would appear at first glance that there would be considerable competition among these producers in finding a market for their oil. However, most of the oil in the United States is produced by the highly integrated companies engaged in all phases of the industry, from production to marketing. In California, nearly all the oil is produced by the larger companies because of the extremely high drilling costs. It is in Mid-Continent and eastern areas, where the independent operators of small means still hold forth in large numbers. Yet in states that lie in this region a few large companies produce the bulk of the oil. Competition in the production end of the business lies primarily in seeking new producing properties rather than in finding a market for the oil already found. According to the reports of the oil operators making gross production tax returns in Oklahoma,[1] where probably there are as many independent operators in proportion to the amount of oil brought to the surface as in any state in the Union, in the third quarter of 1929, there were more than 1,206 who paid a gross production tax. There were several duplications in this list. It is difficult to tell exactly how many actual producers there are, including royalty owners, because of the nature of the accounts listed. By checking over the accounts, there are estimated to be approximately one thousand producers in Oklahoma, individual and corporate, paying a gross production tax. This list did not include royalty owners with a royalty value of less than $2,000 and operators who produced less than $5,000 worth of oil during this quarter. If these were added, the number in Oklahoma would be increased considerably.

The companies producing more than a million barrels during this quarter are listed below. This includes royalty interests as well as actual production.

1. *The Oil and Gas Journal,* November 28, 1929, p. 100.

Barnsdall Oil Company	1,967,358 barrels
Carter Oil Company	2,813,665 barrels
Gypsy Oil Company	3,766,166 barrels
Indian Territory Illuminating Oil Company	1,428,306 barrels
Magnolia Petroleum Company	4,410,265 barrels
Mid-Continent Petroleum Corporation	2,110,805 barrels
Prairie Oil and Gas Company	4,819,184 barrels
Pure Oil Company	1,844,462 barrels
Sinclair Oil and Gas Company	4,339,947 barrels
Shell Petroleum Corporation	1,939,932 barrels
TOTAL	29,440,090 barrels

According to these figures ten companies produced approximately 56.9 per cent of the total amount produced in Oklahoma during this period. This per cent is a little high because royalty owners with a royalty value of less than $2,000 and operators who produced less than $5,000 worth of oil during this quarter were not included.

The statements in the above paragraph may seem to contradict those in a previous chapter. In that chapter it was stated that there is less concentration and control of petroleum resources than in some of the other basic industries. The control of resources and of actual production must not be confused. There is more concentration in production, for quite frequently when new fields are developed the promoters sell out to the established companies and go on to find new ones.

When a new well is brought in by a company owning a pipeline and refinery it runs a gathering line out to the well. There is no problem of marketing oil unless the company is a small one with a large surplus and then the problem of handling the surplus oil, if it does not wish to expand its facilities for handling it, is somewhat similar to that of the producer who has no outlet of his own. Sometimes it happens that a company does not have a sufficient supply in the producing territory near its refinery but it does own a supply of crude in a distant field which it exchanges for oil produced in its vicinity; thus refineries often assist each other in this way in order to save transportation charges.

The unit in the marketing of crude petroleum is the barrel containing forty-two gallons. All prices are quoted in terms of price the barrel. In Europe instead of oil being sold by volume it is sold by weight. Since the volume of a given weight varies with the temperature and gravity, both of these factors are taken into consideration. The standard temperature for this purpose is sixty degrees Fahrenheit. Tables have been devised showing the relation of volume to temperature. When the temperature is above sixty degrees Fahrenheit the volume is discounted a per cent in proportion to the advance in temperature. If the temperature of the oil is below sixty degrees Fahren-

heit an allowance for an increase in volume is made in proportion to the difference in temperature according to the tables.

When an individual operator brings in a well, most of the purchasing companies operating in that area know of it immediately. Practically all of these organizations employ scouts to keep them informed of all developments. The operator sells his production to the company making the best offer. The purchasing company runs its gathering line out to the well and connects up with the operator's flow tanks. The oil is gauged and the company mails its check twice a month for the oil. If there are more than one owning an interest in the well the purchasing company sends its check to each interested holder unless a trustee is designated to receive the checks. In most cases checks for royalty come from the purchasing company instead of the producer, thus protecting the purchasing company and assuring the royalty owner of his money. When interests are sold and transferred the company is advised of the transaction by a division order. As a rule there is no written contract existing between the buyer and seller of the oil. Both parties have the right to terminate their agreement at will. Generally speaking the producer prefers to sell his oil to the bigger purchasing agencies because they are in better position to give greater continuity of service. The smaller buyers frequently are forced to give a bonus in order to be insured of an adequate supply but in seasons of depression and overproduction they are more than likely to discontinue their purchases while the larger companies giving no bonus continue to take the oil. Also in seasons of overproduction if the larger companies are pro-rating their purchases they will run the producer's oil to storage and buy it at the current price when the market justifies it. While the producer must pay for this storage he is not obliged to sell it to the one who has it in storage but is at liberty to sell to any one. If he did not run it to storage he would have to provide his own storage facilities which would cause a greater outlay of money.

Pipeline companies as a rule are not purchasers of oil. Their business is solely one of transportation. Mr. O'Neal, president of the Prairie Oil and Gas Company of Independence, Kansas, one of the largest purchasers of crude oil in the Mid-Continent fields, gives an excellent picture of the way oil is bought and sold in his testimony before the sub-committee of the committee on manufactures of the United States senate in 1922.

Mr. Roe. Will you briefly describe the physical operation by which you obtain possession of this oil from this large number of small producers? (about 13,000 small producers)

Mr. O'Neal. We will start in with a new property. I think in that way I can give it to you more clearly. The producer takes a lease and drills a well. It produces oil. Of course, the first thing, necessarily, that he seeks is a market for that oil. He comes to the

local representative of the Prairie Oil and Gas Company and asks if we are in the market to buy the oil, and he in turn asks the Prairie Pipeline Company if they will lay a line to this well. It may be one mile to this well, or it may be twenty-five or thirty, and sometimes a greater distance. If the well is good enough to justify the line or the investment they lay it. Then we purchase the oil, and the oil is sent to that pipeline as part of our tender of shipment to our customers. The pipeline has nothing to do with the purchase of the oil, and is only responsible for it while carrying it and delivering it to destination.[2]

According to the terms of the average commercial lease the lessor receives one-eighth of all the oil and gas produced. The customary royalty for departmental leases in the Osage nation is one-sixth of all oil and gas produced. The departmental leases of the Five Civilized Tribes vary from one-sixth to one-eighth. The lessors have the option of receiving their royalties in oil or gas or in money. As a rule the royalty owner sells his share at the time the lessee sells his at the price paid for the other seven-eighths, or whatever the lessee's share might be. The royalty is paid directly by the purchasing agency to the royalty owner and there is very little chance for the lessee, if he were so inclined, to defraud the lessor of his share. It is more convenient to sell the entire production of a property altogether than in separate lots and it is largely done for this reason. Many of the royalty owners are people who by a combination of fortunate circumstances happen to be the owner of the land on which the oil is found and know nothing whatever of the operation of the industry. As long as their royalty checks are received regularly they are satisfied, since the only use they have for oil is its monetary return.

In recent years many corporations, some of considerable size, have been organized for the purpose of dealing in oil royalties. Associations of royalty owners have also been formed. These groups are growing in power each year in their ability to influence the price structure. This influence is felt more keenly because of their ability to force production.

Effect of Gravity Basis on Prices

In the early days of the oil industry before gasoline became its major product there was relatively no distinction in the grades of crude oil except the high sulphur oil of Lima, Ohio. Another reason for this may be due to the fact that there was really little difference in the grades because the Pennsylvania fields furnished the bulk of the production. Even the earlier fields of the Mid-Continent area furnished oil of fairly high gravity, although not as high as the gravity of Pennsylvania oils, so marketers did not make any distinction on a quality basis. When transportation costs were considered there was little difference in the price of crude oil from the various oil producing

2. Hearing on the *high cost of gasoline and other petroleum products* held before a sub-committee of the committee of manufactures, United States senate, sixty-seventh congress, second and fourth sessions, Vol. I, p. 241.

sections. When the industry changed over to a gasoline basis from a kerosene basis preference was given to higher gravity crudes.

In 1919 the posted prices of crude oil made a distinction in price of oil according to gravity. The oils of higher gravity have a higher gasoline content and prices were made on this basis. High gravity oil was in greater demand than low gravity oil and refiners could afford to pay more for it. R. R. Irwin, vice-president of the White Eagle Oil and Refining Company, in an address before the Western Petroleum Refiners' Association in 1923, declared that while there is considerable variation in the recovery of gasoline from crude oil of the same gravity produced in different fields, it is a reasonably fair estimate to say that for the Mid-Continent gasoline crudes testing thirty gravity and above, the gasoline content increased two per cent each degree in gravity.[3] Until July 1925 the usual price quotations included six grades and after that date the number was increased to seventeen, when the Prairie Oil and Gas Company announced the new schedule. This schedule has varied since then.

Higher gravity oils received the greatest increase in price. The lowest grade had only an increase of five cents a barrel., while the highest grade had a posted price increase of thirty-three cents a barrel. These differences in price of the various grades of oil have not been maintained consistently by the different purchasing companies operating in the Mid-Continent field since that date and they have also varied according to the demands of the various purchasing companies.

While the figures in the Prairie schedule emphasize the importance of the gravity of crude oil in the general situation, it is reasonable to believe that the importance of high gravity crudes in the general price structure will have a tendency to diminish. The tendency of the refining branch of the industry is away from the skimming plant, (the refinery that takes off the lighter fractions and has no cracking facilities) towards the complete plant, the refinery that not only skims the lighter fractions of the oil run through but also extracts gasoline from the heavier oils by cracking. The skimming plant is losing ground because of its economic disadvantage. The complete plant does not need to compete for the higher gravity oils when it can produce from fifty to seventy per cent of high grade gasoline from fuel oil or gas oil.

There will be a demand for some time to come from small refineries for high gravity oil, although this demand in the future may be only a comparatively small part of the general demand. There is a disadvantage to the purchasing company as well as to the selling company in using a wide range of grades because of the increased amount of bookkeeping necessary in keep-

3. *National Petroleum News,* October 17, 1923, p. 30.

ing accurate accounts which adds to the operating expenses of the company involved. While the purchasing companies, no doubt, are endeavoring to establish as equitable a price as it is possible for them to make, the basing of the price on gravity does not seem to bring about the desired results.

Most of the oil is produced by the highly integrated companies, by those that have either direct or indirect refinery connections, and by those that are subsidiary to companies owning refineries. To the trade, free oil is oil that is produced by companies, or individuals, that do not belong to the Standard group and by companies without refineries. In other words, free oil is oil produced by individuals and corporations who do not have refinery connections. It is practically impossible to tell how much of the oil produced is free because much of it is tied up by contracts, part ownerships, or otherwise, to the larger companies. However, it might be safe to hazard a guess that free oil is not more than twenty-five per cent of the amount produced. This applies to those states, especially in the Mid-Continent field, where there is a wide distribution of ownership of producing properties.

While free oil is only a small part of the total oil produced it plays an important part in the marketing structure. It is on this oil that the independent refiner relies for a large per cent of his source of supply. Because production varies considerably from quarter to quarter, the overlapping of ownership of production, the difficulty in adequately determining the exact refining capacity of refineries that do not own their own sources of supply, because of their irregularity of operation (which may be due to insufficient supply, or other causes), it is practically impossible to compare accurately the refining capacity of those refineries depending on free oil for their source of supply and the amount of oil available. It is evident, however, that the operating capacity of these refineries exceeds the supply and here hangs the most serious problem of the small refiner. As President Nichols of the National Petroleum Marketers' Association has said it is accepted as axiomatic that to be successful, an independent refiner must be protected by an individually owned or controlled crude supply, and also the jobber whose refinery connection is not in this enviable position, has not a dependable source of supply. In order for the refiner of this type to be assured of a source of supply it is necessary for him to resort frequently to giving premiums for his oil. This increases his cost of production and in seasons of depression, which occur too frequently in the industry, places him in an embarrassing position. In recent years the seasons of overproduction of crude oil have been occurring at intervals of greater frequency. When there is a condition of overproduction and the supply is more than the demand, then the refiner who is dependent upon free oil for his plant can purchase his supply at the posted price, or

sometimes under the posted price. But when the day comes when we shall see an end to our resources and production begins on that long descending curve, never to rise again, then the lot of the independent refiner will be an unenviable one indeed.

Meaning of Overproduction of Oil

At this place it is appropriate to explain what is meant by overproduction of oil. There is some confusion as to meaning and various authorities give the expression different interpretations. The price of petroleum is made in a world market. According to the preliminary report of the United States bureau of mines the United States produced 67.6 per cent of the world's petroleum in 1929. In 1928 the United States produced 68 per cent and in 1927, 71.4 per cent. Although the United States produced 67.6 per cent of the oil in 1929 the 32.4 per cent that was produced in foreign fields was sufficient to affect the price. If there had been no foreign oil produced, it is safe to say, all other conditions remaining the same, the price would have been considerably higher. Overproduction, then, is a condition wherein so much crude oil is available that a satisfactory and reasonable price is not received for the product. Overproduction will be used in this sense in this book.

Overproduction is construed by some to mean a condition prevailing where domestic production exceeds domestic demand, not considering imports and exports.[4] No study of the problem of stabilization of the petroleum industry would be complete without taking into consideration the influence of foreign production and foreign markets. Overproduction must be used here to include their influence.

It is true, however, that there may prevail at any time, regardless of the market, a condition of physical overproduction. This condition may occur in a particular locality, where the facilities for handling the oil are inadequate to take care of the oil produced.

Oil Exchanges

Frequently writers for the popular press suggest that an exchange for the buying and selling of oil should be organized along the same lines as the commodity exchanges in order to stabilize prices. There is no oil exchange, not because the leaders in the industry are opposed to such a scheme, but because an oil exchange is not justified on general economic principles. For an organized exchange to function there must be a large body of buyers and sellers. In the oil industry the number of buyers is out of proportion to the number of producers. It is estimated that there are about 9,000 producers of crude oil in the United States and only about 479 refineries. Out of

4. J. Edward Jones, *A Brief Analysis of the Crude Oil Overproduction Problem*, pamphlet, January 18, 1930, p. 6.

this number 362 with a daily capacity of 3,721,360 barrels were operating in 1930. The number shut down was 117 with a daily capacity of 251,100 barrels.[5] In order for a commodity exchange to function satisfactorily the commodity must be susceptible to accurate grading. While crude oil is bought and sold according to the grade based on gravity, the distinction based on grades is not sufficient to justify trading on an exchange. The higher gravity crudes do not have a gasoline content in proportion to the gravity. The reduction to one grade or to a few grades by mixture would have exterminated the small refiner, who have made their success on their ability to select particular grades of oil with superior qualities for the special products they desire to market.

In order to establish an exchange for the marketing of crude oil it would be necessary to revise completely the present system of marketing. Whether or not the costs attendant to such a change would be justified is questionable. It would most certainly revolutionize present methods of storing and transportation. It would add greatly to overhead, because it would be essential to create middlemen and extra machinery to perform services that are now almost wholly rendered by producers and consumers themselves.

In the early eighties oil exchanges were established at Oil City, Titusville, Bradford, Petroleum Center, Philadelphia, New York City, and other places. Speculation went wild on these exchanges while the actual buying and selling of oil took place outside. Those who bought and sold on the exchange were as a rule not oil men but representatives from every walk of life, from barkeepers to ministers of the gospel. Through sudden shifts in the market large fortunes were made and lost. These exchanges failed because they became purely speculative institutions.

If the oil industry could turn a spigot when it needed to replenish its supply of oil, most of its serious problems would be solved. Unfortunately its supply cannot be regulated in such manner. Nature is either bountiful or niggardly. The production of oil cannot be regulated according to demand, so therefore, much of it must be stored above ground. This problem frequently becomes acute in the fields of flush production where the flow cannot be shut in conveniently and storage must be provided for above ground. When the supply of petroleum falls off there follows an intensive drilling campaign which results in the bringing in of new wells and an oversupply. The supply exceeds the demand and the industry is thus forced to take care of the surplus product. At no time in the history of the industry has the ideal been approached where oil could be produced at a rate approximating its consumption, with only a limited reserve for contingencies.

5. *The Oil and Gas Journal*, March 6, 1930, p. 139.

Storage of Crude Oil

There are two types of storage of crude oil, pipelines and tanks. There are four types of storage tanks, namely, steel, wooden, earthen, and concrete. The total capacity of the approximately 90,000 miles of pipelines in the United States is estimated at 16,000,000 barrels of forty-two gallons.[6] Of the tank storage it is estimated by the bureau of mines that steel storage comprises eighty per cent of the total. The amount of wooden storage is almost negligible. The remaining twenty per cent outside the amount allowed for wooden storage is about equally divided between earthen and concrete storage. Steel tanks, although more expensive, are better than the other kinds because evaporation losses practically are eliminated. Evaporation losses are, of course, higher from earthen storage but this type is seldom used except in fields of heavy gravity crude such as the older fields of California production. It is customary to paint steel tanks with aluminum paint because experience has proved that the evaporation loss from tanks of this color is less than from tanks of other colors, especially black.

The following enumeration shows the storage capacity according to kinds of crude oil as reported by the bureau of mines for May, 1926:

Steel	458,040,000 barrels
Wooden	3,315,000 barrels
Earthen	78,575,000 barrels
Concrete	36,799,000 barrels
TOTAL	576,729,000 barrels

Most of this storage is located at tank farms distributed throughout the country. California is the leading state in point of storage capacity with over 200,000,000 barrels of tankage. Texas is second with 170,000,000 barrels. Oklahoma ranks third with a storage capacity of 140,000,000 barrels. California is the only state to use concrete storage to any extent, because of the flush production in 1923 and years immediately following. California also leads in earthen storage for the same reason. Arkansas ranked second at that time in amount of earthen storage, due to the flush production from the Smackover field. On the Atlantic coast there are about 20,000,000 barrels of tankage for the storage of crude oil and at the ports on the Gulf of Mexico the storage capacity for crude petroleum is estimated at 75,000,000 barrels. The storage for refined products on the Atlantic and Gulf ports far exceeds that for crude petroleum, because the export business is mostly in refined products.

Most of the crude oil held in storage is owned by the large purchasing companies and stored in the large tank farms scattered over the country at

6. The data on storage capacity are taken from Information Circular No. 6016, of the department of commerce, bureau of mines, January, 1927, by G. R. Hopkins and A. B. Coons.

strategic locations. It is estimated by the bureau of mines that 80,000,000 barrels of the total crude oil storage are found at the refineries. As old fields decline and new ones are developed storage equipment is moved from the old to the new locations as the demand requires, making it very difficult to estimate exactly the total storage capacity in the United States. The question of storage becomes a serious problem frequently in fields with flush production. While there may be empty tanks in some sections of the country an acute shortage of storage capacity may occur in others.

The carrying over of a large surplus of crude petroleum adds a burden of expense to the industry, since it costs on the average fifty cents a barrel to erect steel tankage in the fields for the storage of crude, about thirty-five cents of this representing the materials and labor and from five to fifteen cents the cost of the three acres of land required for each tank. While tanks vary in size the most common type used at the tank farms is the "55," 55,000 barrel capacity. These have a diameter of one hundred fourteen feet six inches, and are thirty feet high. Tanks with a capacity of 37,000 barrels are commonly used. When tanks of the two types here given are built they are placed about five hundred feet, center to center, making the distance, shell to shell, about four hundred feet.

Much of this storage is filled only once, so that a charge of from forty to fifty cents a barrel must be added to the price paid for the oil coming into these tanks. Of course, pipeline storage located at important junction points is filled and refilled several times. The cost of carrying the oil after the tankage is paid for is almost as much. Light gravity oils evaporate faster than do the heavier oils. It is estimated that taking the country over, it costs on an average of about thirty-five cents a year the barrel to store crude oil. This total is made up of charges for interest on the oil, interest on the cost of tankage, labor for repairs and watchmen, insurance, evaporation loss and taxes. Where crude is run into tanks especially built for it and used but once, the cost of a barrel is immediately increased fifty cents over the price paid for the crude.[7]

It has only been since 1919, when purchasing companies began to buy oil on a gravity basis, that the industry has given serious consideration to the problem of evaporation losses from petroleum in storage. Today the use of tight tanks has become universal in the Mid-Continent field. Competition among the tank manufacturers, also, is responsible largely for the increased improvement in oil tank construction. This improvement has so developed that it is possible to hold oil practically at the same gravity at which it is produced until it is run by the pipeline company. There are two reasons

7. *The Lamp*, April, 1928, p. 3.

why it is important for the oil companies to preserve the gravity of their oil: high gravity oil sells at a higher price, and, as oil evaporates, it loses volume. Therefore, the owner of the oil not only loses in the grade but also in the volume of his product. Mr. J. R. McWilliams, production engineer of the Skelly Oil Company states that a loss of one degree in gravity means a loss of two per cent in volume for oil above thirty-nine degrees gravity, one and one-half per cent for oil between thirty-two and thirty-nine degrees gravity and one per cent for oil below thirty-two degrees. Mr. McWilliams estimates that the tanks on the properties of his company more than pay for themselves through the saving from evaporation losses.[8]

According to *The Lamp,* organ of the Standard Oil Company of New Jersey, surveys of the various fields east of the Rockies have shown that the gasoline content of the crude increases at the average of about seven-tenths of a gallon to the barrel for each degree rise in gravity. When a change in the gravity price schedule was made effective in the middle of 1925 the wholesale price for gasoline was approximately ten and a half cents the gallon above that for fuel oil. The differential of eight cents the degree of gravity in the crude price schedule then represented the difference in the wholesale price as between gasoline and fuel oil.[9]

The purpose of stocks in storage originally was to furnish a supply in time of need. They were intended to stabilize prices by offering a certainty of supply when production should decrease, thus acting as a shock absorber against periods of shortage. There has been no period of actual shortage within the last decade, in fact, there has never been a serious shortage since Drake's discovery in 1859. Owners of stocks have been reluctant to draw on them, for oil in storage is more costly than oil on the market. When prices are rising, instead of drawing on the reserve, refiners have bought additional supplies which helped to support the price level, which, in turn, stimulated drilling which augmented supplies, thus again bringing down the price.

It is believed generally that the price of crude oil determines the price of gasoline. This is the view expressed, for instance, in the *National City Bank Letter,* monthly publication of the National City Bank of New York, in the issue of March, 1926. The *Letter* cites figures to prove its contention, but a close analysis of these shows that there were only three changes in price, where the movements were in the same direction, to eight changes made in the opposite direction.

A careful study made by this writer reveals quite the converse, viz., that

8. *National Petroleum News,* April 20, 1927, p. 61.
9. *The Lamp,* February, 1927, p. 22.

the price of gasoline as often influences the price of crude oil. It is a logical development, since the increased use of cracking facilities and of natural gasoline has decreased the demand for crude oil, and, at the same time, created a greater supply of gasoline. This greater abundance of gasoline has tended to lower the tank car markets, and these in turn have had a depressing influence on the crude market. Prices of crude cannot be established on the cost of crude oil already in storage but must depend on that price the industry can obtain for its products.

The coefficient of correlation of the prices of crude oil and gasoline reveals however, that there is really little relationship between them. We may arrive at this coefficient by studying the prices respectively of 33-33.9 degree gravity crude in the Oklahoma, Kansas and North Texas fields posted by weeks during the years of 1927, 1928 and 1929 by the Prairie Oil and Gas Company and of United States motor gasoline, Oklahoma refinery, group three, for the same period. Correlating these two series, we find their coefficient to be .383. Now, had we had the coefficient of plus one, there would have been a perfect direct relationship. Were this the case, when the price of crude oil advanced, there would be a corresponding advance in the price of gasoline. That is, both would ascend and descend together in the price scales.

Had our coefficient shown a direct relationship, it would not have revealed which was cause and which, effect. Price depends on what is the limiting factor in the industry. If crude oil is very scarce, it will be the limiting factor and so determines the price of gasoline. A plentiful supply of gasoline, in like manner, may depress the price of crude oil. How the limiting factor tends to influence prices may be discovered in the depressed state of both gasoline and crude markets in recent months. Gasoline supply has been plentiful, due to the improved technique of refining, so plentiful, in fact, that the amount of gasoline forced on the market has been entirely out of proportion to a demand great enough to support the price. The depressed price of gasoline, in consequence, reacted on the price of crude oil, causing a corresponding decrease in price on the latter. Thus, while in this specific case gasoline price reacted on crude prices, we have seen that we cannot say in truth that the price of gasoline has had more influence on that of crude than has crude on the price of gasoline. In every case, it is the limiting factor in supply and demand, homely as they may be, that determine the price scale.

It was shown in Chapter V that there is little relationship between the number of wells drilled and the business cycle. It may be demonstrated also by the same method that there is little relationship between the prices of crude oil and the general index of wholesale prices. Prices of 33-33.9 gravity

crude in the Mid-Continent field as posted by the Prairie Oil and Gas Company for the years 1921 to 1929, inclusive, by months, were correlated with the bureau of labor's index of wholesale prices for the same period. The coefficient of correlation was found to be .320. This coefficient indicates that there is very little relationship between the two series and that there are forces determining the price movement of crude petroleum other than those that determine the general movement of the prices of wholesale products. This fact is evidence that the problem affecting the petroleum industry is one peculiar to it alone. Data from which the coefficient of correlation was computed may be found in the Appendix, Table IV.

The refining industry has been one of decreasing costs for the past decade. Competition has been severe. This fact is borne out by the mushroom growth of filling stations all over the country. In order to meet this competition refiners have been striving for volume in order to cut the costs.

The effects of this policy are seen in the preliminary report of the United States bureau of mines for the year 1930, issued in February, 1930. Runs both domestic and foreign to stills of crude petroleum in 1929 amounted to 987,708,000 barrels, an increase of eight per cent over 1928. All this increase was in domestic crude because foreign importations fell off about 2,000,000 barrels. Stocks of gasoline at the end of the month, December, 1929, were 43,115,000 barrels as compared to 33,066,000 at the same period in 1928.

A point has been reached in the industry where something should be done to curtail volume production. In March, 1930, Dr. Ray Lyman Wilbur, secretary of the interior and chairman of the federal oil conservation board, wrote to the governors of the states of Oklahoma, Texas, and California suggesting that refineries in these states shut down on Sunday to prevent a further overproduction of refined products. Secretary Wilbur said: "Stocks are higher than they have been since 1927, while the domestic demand is only up to the level of 1928."

The Associated Press of March 5, 1930, carried the announcement of the Standard Oil Company of New Jersey that effective March 9, refinery operations would be reduced to a six-day week basis following the recommendation of the federal oil conservation board. Plans for similar action were announced by the Humble Oil and Refining Company, a subsidiary of the Standard of New Jersey.

The Oil and Gas Journal in its annual refinery number gives the total daily refinery capacity in the United States as 3,972,460 barrels. Out of this total 117 refineries with a daily capacity of 251,000 barrels were shut down. It is estimated that 2,700,000 average daily run of crude to stills in 1930

would furnish all the gasoline and other petroleum products needed.[10] This excess refining capacity has brought about an overproduction of motor fuel stocks which has had as unstabilizing influence on the industry as the overproduction of crude oil.

Estimates of Future Supply

There have been various estimates of future supplies made from time to time, which have had their influence on the industry. These estimates, as a rule, have been very conservative. They have served to cause the larger units in the industry to maintain large stocks in storage.

Below is a summary of the estimates of future production beginning with David T. Day's estimate, made in 1908. There is also given the per cent of error of these estimates as far as we know now. These estimates serve to prove how futile it is to make a prediction of what the future supply may be. This uncertainty of the future supply is the reason for the conservatism in the industry even though the production curve has been moving upward.

1908—David T. Day, chief geologist United States geological survey.
Estimated a minimum of 8,500,000,000 barrels.
Estimated a maximum of fifteen to twenty-two and a half billion barrels.
From 1908 to 1929, inclusive, United States produced 10,441,447,000 barrels.
All of Day's minimum, plus twenty-three per cent.

1914—Ralph Arnold, petroleum engineer.
Estimated future production at 5,700,000,000 barrels.
From 1914 to 1929, inclusive, the United States produced 9,178,396,000 barrels.
All of Arnold's estimate, plus over sixty-one per cent.

1915—United States geological survey (revised statement of Day).
Estimated future production at 7,600,000,000 barrels.
The United States produced 1915 to 1929, inclusive, 8,912,633,000 barrels.
All of that estimate, plus seventeen per cent.

1918—David White, chief geologist, United States geological survey.
Estimated future production at 6,700,000,000 barrels.
The United States produced 1918 to 1929, inclusive, 7,995,446,000 barrels.
All of White's estimate, plus nearly twenty per cent.

1921—Certain petroleum geologists of the American Association of Petroleum Geologists.
Estimated future production at 9,150,000,000 barrels.
The United States produced 6,818,222,000 barrels, nearly seventy-five per cent in nine years, 1921 to 1929 inclusive.

1925—Committee of Eleven of the American Petroleum Institute.
Estimated future production from proven acreage by present methods, 5,300,000,000 barrels.
The United States produced 1925 to 1929, inclusive, from these properties and new pools—4,343,161,000, almost eighty-two per cent.[11]

10. C. O. Wilson, "Capacity Nears Four Million Daily," *The Oil and Gas Journal,* March 6, 1930, p. 138.

11. *American Petroleum—Supply and Demand,* McGraw-Hill Book Company, 1925, pp. 41-54. This book is a report to the American Petroleum Institute by the committee of eleven.

1929—In 1929 the United States produced 1,488,604,000 barrels, compared with 901,474,000 barrels in 1928.

(United States bureau of mines, preliminary report)

1857—to 1929, inclusive, from the beginning to date, the United States has produced a total of approximately 12,732,279,000 barrels.

The production is now over a billion barrels *per annum* with the production curve on the up-grade.

When the Seminole pool began to decline in the fall of 1927 and the boundaries of this area had been determined President E. B. Reeser of the Barnsdall Oil Corporation was moved to ask, "Has the turning point been reached?"[12]

The Oil and Gas Journal was prompted to inquire, "After Seminole, What?"[13] In this editorial the editor said that executives of large integrated companies who represented great investments must be assured constantly of a future supply. Overproduction is unexpected; underproduction must be guarded against. This expresses the attitude of the larger companies. No company with huge investments tied up in the business can afford to take a chance and for that reason large stocks are held.

Since the Seminole field was opened at least three large pools have been discovered that are as large, if not larger, the Oklahoma City pool, near the Seminole pool, the Yates pool in Texas, and Kettleman Hills in California.

Dr. George Otis Smith, director of the United States geological survey, is quoted as saying that he is convinced that Kettleman Hills would produce 2,000,000,000 barrels.[14] It is estimated that all three pools, Oklahoma City, Yates, and Kettleman Hills, have a potential production of 5,000,000,000 barrels. Paul D. Torrey, in a paper read before the February, 1930, meeting of the American Institute of Mining Engineers in New York, estimated that flooding will recover 600,000,000 barrels of high grade oil in the next fifty years from the Bradford and Allegheny fields of Pennsylvania.

In spite of the fact that the production curve of petroleum has been steadily rising it is just as true that when one barrel of petroleum is taken from the ground there is one less underneath. There is no way of telling exactly what may be the future reserves. It is therefore necessary for those directly involved to guard themselves against the time when the production curve will turn on the down grade. Until that time does come, however, the large stocks held in reserve will have a depressing influence on prices and the stabilization of the industry unless a price level can be maintained where it is profitable to carry this large reserve.

12. E. B. Reeser, "Has the Turning Point Been Reached?" *The Oil and Gas Journal,* October 10, 1927, p. 38.
13. *Ibid.,* p. 44.
14. *The Oil and Gas Journal,* February 20, 1930, p. 168.

One of the best remedies for cutting costs of storage and at the same time maintain an ample supply is to eliminate competitive drilling and regulate production through proration. Methods of proration will be discussed in the next chapter.

Problem of Crude Oil Prices

There is no problem in the oil business that deepens the furrow on the brow of the oil man more than the problem of prices of crude oil. The change in price affects every branch from production to retail marketing. When and where a well should be drilled is determined largely by the price of crude oil. The refiner is influenced in his operations largely by the price of the supply of his raw material. The marketer also is interested because the price he receives for his products is influenced by the price of the raw material. The price of leases and royalties fluctuate in sympathy with the price of crude oil. And last, but by no means least, the public is interested in the price of oil because there is hardly no one living in the civilized world today who is not affected, either directly or indirectly, by its movements. So, therefore, price regulation is one of the most important problems connected with the business.

It was explained above why there were no exhanges for the marketing of petroleum. There must be a large number of buyers and sellers. The commodity must be of uniform and standard quantity with a standard unit. While petroleum may be graded, and its standard unit is a barrel of forty-two gallons, the equilibrium between the number of buyers and sellers is not such that would warrant the satisfactory operation of an organized oil exchange. Fundamentally there is no difference between the operation of the forces of supply and demand on an organized exchange and in an unorganized market. The buyers and sellers meet openly in an organized exchange and the prices are given more publicity. The buyers and sellers meet privately in the unorganized market, therefore prices are registered individually. In this way prices are not given as much publicity and therefore are not as sensitive to supply and demand as on the organized market. While these prices are not as uniform as those of the organized market the buyers and sellers can "feel" the market and know fairly well what the general level of prices is under the prevailing conditions. Petroleum, lumber, copper, and cement are commodities of general use and distribution but because of their nature and use they are not adapted for marketing through organized exchanges. Because there are fewer producers than consumers and because the demand for some of these products is not sufficiently elastic it is impracticable to market them like wheat and cotton. There is not enough competition either in the buying or selling, as there is in wheat and cotton, to justify an exchange.

Prices of commodities on the organized exchanges are more sensitive and susceptible to fluctuation than the prices of the commodities marketed individually. It will be noted that the price curve of wheat is like the tooth of a saw. It moves downward and upward and *vice versa* in an irregular manner. On the other hand the price curve of crude petroleum moves in a more regular fashion. There will be a considerable period of time when the level of prices will not be broken and the curve will resemble a plateau, so to speak, and then, suddenly, the curve will be broken with a long downward or upward sweep to continue again in an even way until another abrupt price change takes place. This type of curve is not peculiar to petroleum. Any standard graded commodity which has no organized exchange may have a price curve of similar description.

The buyers and sellers meet individually and the resulting price is made through bargaining. It must not be understood that all the prices made through individual bargaining are uniform. They are not uniform but they have a tendency to concentrate around a given point. The quotations are nominal and are not the actual prices at which the current transactions are made. Sometimes these commodities are sold on contract with reference to future deliveries which fact would influence the stability of prices.

It is not infrequently said that crude oil prices are fixed arbitrarily by a few individuals. These accusations are heard often in the areas where there are many small independent producers, often made in the newspapers, and made from the platform by politicians. Senator Trammell in a debate on senate resolution 31, sixty-ninth congress, first session, declared,

> following up their custom of periodically advancing the prices of oil when business is best, they have recently advanced the prices of gasoline throughout the country, and the way in which it is done indicates that there is a concert of action, and certainly an indirect violation, if not a direct violation, of the anti-trust law.[15]

The federal trade commission was instructed by the senate according to resolution 31, mentioned above, to make an investigation of the industry with special reference to prices. The commission, in its letter of submittal of the report, said:

> In general as to the prices of crude petroleum this inquiry tends to establish the conclusion that the price movements for the longer periods are substantially controlled by supply and demand conditions, but that these conditions are reflected quite imperfectly in shorter periods, partly because crude prices are determined by the decisions of a few large purchasing companies among which there is generally little real competition....
>
> Restrictions of production of crude oil in particular fields have occurred from time to time as a result of concerted action of producers. Information obtained in this investigation indicates that agreements made in 1926 and in 1927 by officials of the largest oil com-

15. Senator Trammell, *Congressional Record*, May 21, 1926, p. 9811; Federal trade commission, *Petroleum Industry—Prices, Profits and Competition*, 1928, p. 3.

panies in the country, to restrict production of crude petroleum in the Seminole fields had for their object the protection of the profits of the companies by preventing further declines in crude prices and consequently in the prices of refined products as well as the preventing of the physical waste of petroleum, which, while threatened, has not occurred apparently to any considerable extent. In this policy they have been aided, moreover, by the public authorities of Oklahoma, who ultimately imposed restrictions on production.[16]

There are some yet who believe that the Rockefellers, father and son, dictate the price of oil. Although John D. Rockefeller is a substantial stock holder in the Standard Oil group he has not taken an active part in the determination of policies since he retired several years ago. John D. Rockefeller, jr., does not take an active part in the management of the companies. The most active part he has taken in regard to the management of any of the group was to assemble enough votes among the stockholders in the Standard Oil Company of Indiana to depose Colonel Stewart from the chairmanship of the board of that company in 1929.

John D. Rockefeller, jr., was forced to deny through the press of February 27, 1930, that he and his father had anything to do with the cut in the price of crude oil in January, 1930. He said,

neither my father nor I knew anything about the recent cut in crude oil prices until we read of it in the papers. The oil companies in which we are interested are managed, and their business policies determined, by their officers and directors, and not by their stockholders. I must emphatically deny the statements that Father has again taken the initiative in dictating oil policies and that it was he who directed the Standard interests to order a cut in the price of Texas and Mid-Continent crude oil.[17]

In those industries in which there are relatively few important producers or consumers the prices determined upon by the leaders in their respective industries are usually the prices followed by the small operators. Fifteen companies purchased fifty per cent of the petroleum produced in the United States in 1924, 47.7 per cent in 1925, and 51.3 per cent the first six months of 1926.[18]

So much capital is required in the oil business to build pipelines, storage facilities, and provide other equipment necessary for the marketing of petroleum that only a few individuals or corporations can afford to undertake the enterprise. Also considerable capital is required to build a refinery. Each year the building costs for refineries are increasing because of the highly technical devices required to meet the ever increasing demands of competition. When a leader of this type in an industry dealing in a commodity that is not bought and sold on an organized exchange makes a price the smaller ones in that industry follow his price. Small producers may make different prices, and usually do, but those prices do not affect the general market. There is

16. Federal trade commission, *op., cit.,* pp. xix and xx.
17. Associated Press, *Oklahoma City Times,* February 27, 1930.
18. Federal trade commission, *op. cit.,* pp. 105-106.

not sufficient volume of business to affect it. When prices are rising and there is a brisk demand for crude oil they may sell at a higher price or receive a bonus for their products. When prices are falling and the demand is slowing up these producers usually sell at a price lower than the posted price.

What is a posted price and how do the larger operators determine what this posted price shall be? There seems to prevail in some quarters and among certain classes of people that somewhere, probably at 26 Broadway, that a group of men get together around a large table and there arbitrarily agree what the price shall be and this price is the price by which all must abide. It is no doubt true that the directors at 26 Broadway may assemble, as they usually do, in the board room at eleven o'clock each day and there decide what they will pay for crude oil. The factors that cause them to determine this price, or that, or whether it shall go up or down, as far as they are concerned are many. It may be the amount of crude oil they have in storage, the weather, the bringing in of new wells, the foreign demand, competition by other prominent buyers, all of these and others relating to supply and demand are factors that determine prices. But the government is too watchful, the competition too keen, the public too wise, in this day and time for any single oil company or group of companies to dictate the price arbitrarily without regard to economic conditions.

President Walter C. Teagle of the Standard Oil Company of New Jersey is quoted by the federal trade commission as to what statistics are used as the basis for the formulation of prices of crude petroleum by his company. The Standard Oil Company, through its susidiaries, is one of the largest purchasers of crude petroleum in the Mid-Continent field. Mr. Teagle is quoted by the commission as saying:

There are three principal statistics of equal importance. These are the figures showing stocks above ground, current production, and current consumption. Almost everyone in the oil business is familiar with the figures as to the latter two, but few, indeed, pay any attention to the first item. Just as soon as a barrel of oil has been paid for and put into storage it ceases to exist in our minds, and yet as a matter of fact this is one of the three legs of the tripod on which the price structure rests. It was the industry's failure to keep this leg of the tripod in adjustment with the other two that caused the present upset. The purchasing companies and the refiners are paying the bill for carrying this oil, but they must pass along a share to the producers in the form of price changes at the wells. Of late years, the slightest excess of consumption over production has served to stimulate renewed efforts to bring in more wells, with the result that the industry is keeping itself poor by an overproduction which makes for low prices, while it is paying more than $130,000,000 a year for carrying a reserve above ground which has not been used as a reserve. . . .

I do not known what might be a safe reserve of crude and products. That would vary with the current production and consumption, and oil in sight. It is, however, patent that for some years we have been carrying too much oil and that we could stand a material reduction before stocks would reach a point that would necessitate the bringing in of new

production. Every barrel of crude oil above ground today means more than it did a few years ago, because crude is no longer our source of gasoline. The industry acquired the habit of carrying large stocks before the cracking processes became such an important factor in refining. In view of the extent to which fuel and gas oil are now being run for gasoline, every barrel of crude oil in storage is the equivalent of almost two barrels in the ante-cracking days.[19]

Figures from 1920 through 1929 representing the monthly production of crude oil run to refineries, stocks on hand, and prices of crude oil may be found in Table II of the Appendix. It may be observed that there is a great deal of sympathy among these data. The prices are those of the Prairie Oil and Gas Company's posted for 33-33.9 degree gravity crude in the Mid-Continent field. Although this price represents only one grade in one field there is a close enough relationship among the prices of all crude oils from all areas that this series may be taken as representative. Prices of crude oil are made in a world market and any factor that would affect the price in one area would influence the price in other areas.

It was mentioned in a previous paragraph that crude oil was bought and sold on exchanges in Oil City, and other Pennsylvania centers beginning in the early seventies and continuing through the eighties to the early nineties. During the eighties speculation became so wild that, finally,

on January 23, 1895, the Seep Purchasing Agency of Oil City, on behalf of the Standard Oil Company, posted a price that thereafter, the prices paid by it to oil producers "will be as high as the market of the world will justify, but will not necessarily be the price bill on the exchange for certificate oil."[20]

This practice of posting prices has been followed by the larger purchasing companies down to today. When a large purchasing company determines the price it will pay for crude oil it wires the price to its various offices located in the fields where the company is buying oil. The price is posted on a board where it can be seen by those who are interested. This price is known as the posted price. The various trade journals publish these prices as posted by the leading companies and it is from these publications and the daily press that the public and general trade are kept informed as to current prices. The posted prices of all companies do not always agree. The crude oil gravity price table of the leading trade journals will show variations in prices posted by the leading purchasing companies. These prices differ as to base paid for oil below a certain gravity or the price paid for oil above a certain gravity. The differentials in regard to grade is about the same. These tables show that when a purchasing company makes a change in price the others follow in a few days to meet the price.

19. Federal trade commission, *op. cit.*, p. 108.
20. Gilbert Holland Montague, *The Rise and Progress of the Standard Oil Company*, Harper and Brothers, 1903, p. 131.

The Prairie Oil and Gas Company is one of the largest purchasers in the Mid-Continent area and most frequently has led in the change of price. According to the federal trade commission, comparison of the dates of crude price changes made by this company prior to June, 1928, with its own stocks of crude, shows that its prices generally were increased when its stocks were being depleted and reduced when they were accumulating, but that frequently it advanced or maintained prices when stocks in the Mid-Continent field were increasing.[21]

The main reasons set forth by critics that prices are arbitrarily fixed, especially when they are high, is that the company may have desired inventory position for the purpose of annual reports and financial statements. The prices are sometimes held at an unreasonable figure, according to some critics, because of large bank loans, and lastly the prices are upheld for the protection of large crude contracts running over a long period of time. Others maintain that prices are lowered arbitrarily at times in order for the large companies to fill their storage with cheap oil. Now let us consider these points. The financial statements of many oil companies during the years 1927, 1928, 1929 and 1930 do not substantiate the statement that prices have been high to give a desired inventory position. The inventory position has been desired well enough but no company is large enough to control the price to bring such a condition to pass. Neither can a combination bring it about. As far as upholding prices is concerned to protect large bank loans, the bankers are as well informed in regard to the forces at play affecting the oil industry as the oil men are and bankers are not likely to let themselves get in a position where it would be necessary for the oil industry to maintain an artificial price level to protect the loans. All those engaged in handling crude oil want high prices, especially those who have large contracts for delivery of crude running over a long period of time. While it is true the number of companies engaged in the business on a large scale are comparatively few in number, no single company is large enough to hold up the price for a sufficient length of time to assist materially in this form of contract, whatever else might have been the result. It has been nearly two decades since the dissolution of the old Standard Oil Company of New Jersey which brought about a condition of competition among the major companies, a condition of competition that is nearly ruinous to the industry. It is true that the larger companies do fill their storage with cheap oil. They do it because they have the storage and because the oil is cheap. They are in better position to buy cheap oil than any one else because they have the money and when oil is cheap is the time to buy it. But the leaders in the industry do not force the

21. *Letter of submittal and summary of report on gasoline prices in 1924 to the president of the United States* by the federal trade commission, June 4, 1924, p. 17.

price down arbitrarily in order to fill their tanks with cheap oil. Other conditions bring about the low price of oil and the large companies take advantage of the situation because they are in a position to do so.

The oil industry is often very sensitive to the operation of the forces of supply and demand. It does not take an actual shortage of oil to bring the prices up. An apparent shortage or an apparent oversupply of the product will go a long way in influencing the price trend.

Oil is not like wheat, corn or cotton. If the crops are short this year there is a strong probability that the deficiency can be made up by planting a larger acreage next year. Oil is more uncertain. Its supply cannot be expanded and contracted in such manner. It is a gift of Nature. When once it is taken from the ground it cannot be replaced. Many scientists have startled not only the industry itself, but the general public and have created the impression that our oil resources are near extinction. These scientists may be right and they may be wrong. So far there has been sufficient oil. In fact, so much, that its utility has been lowered. But regardless of the supply available now there is a fear continually lurking in the background that creates a feeling of uneasiness among oil men when storage is being drawn on to meet an increasing demand. Consequently the price rises faster under such conditions than it would in most of the other primary industries.

As crude oil prices go up drilling activities are correspondingly stimulated. The lure of large profits is no less in this industry than in others. The bit is sunk deeper in old fields and new ones are explored. Wildcatters renew their energies, derricks are erected in strange places, and the search for oil goes on in a feverish manner with high hopes for abundant rewards.

When prices are low there is very little drilling going on in fields of settled production. In the fields where wells may be brought in producing several hundred barrels a day the cost per barrel is very small and producers go on exploring for oil because they may make a profit at most any price much to the discomfort of the owners of small producers in the settled fields. The owners of this type of production do not only suffer from a reduction of oil produced but their situation is made more acute by the lowered prices. In May, 1927, when prices were very low there was one company operating in Oklahoma that had 1,833 producing wells and it was making one-seventh of a cent the well daily.[22] There were other companies in a more precarious position than this one. The low margin of profit was due to the fact that about two hundred and fifty wells in the Seminole field had flooded the market with oil. These wells were pinched in and could have furnished more oil for the already overburdened market.

22. *The Oil and Gas Journal*, May 26, 1927, p. 180.

It is not the cost of drilling wells that are producing oil today that affects the price. It is the amount of oil that these wells are producing that aids in determining the price at which the oil will be sold. But the present cost of production may be of influence in determining future prices. If the cost of drilling increases, producers, or those contemplating the drilling of new wells, will not undertake the bringing in of new wells unless the price of oil will justify the expense. Because the element of risk is greater in the oil industry than in any other extractive industry the chance for a reward must be correspondingly greater. Therefore, the present price of crude oil will either stimulate or retard new drilling in wildcat areas. In periods of price depression frequently operators produce oil at a loss. Their lifting charges are more than they receive for the oil. They keep their wells producing instead of shutting them down, hoping that in the future the price may increase where they can make a profit not only on the oil produced at that time but a sufficient profit to eliminate the losses incurred in the past.

The price of oil does affect drilling costs in this respect; the low price of oil curtails drilling activities. This in turn gives the drilling contractors less work to do. These contractors have expensive equipment that is forced to lie idle. Rather than not use their equipment at all they would rather lower their prices to a point where interest charges and wages could be met, hence some of them make contracts at a considerably lower figure than they ordinarily would when the prices of crude oil are higher. Periods of depression are consequently prolonged. Owners of leases with limited means take advantage of the reduced drilling costs and contract with the drillers to put down wells on their properties. Usually these contractors take an interest in the lease as part payment with enough cash down to meet current expenses. Fortunately for the industry as a whole many of these wells come in dry. Some of them, however, are producers and good producers at that. This production adds to the sum total and tends to hold down the price, adds to the extravagance in the use of the product, and demoralizes the trade generally.

Theoretically, the petroleum industry is an industry of increasing costs. Oil is being found and produced at lower and lower depths. It would appear at first thought that the oil obtained at the lower depths would cost more than the oil from higher horizons. This is not always true. The pressure is greater in the deeper sands and the pools are more prolific that the cost a barrel is less. Leases, however, are more costly in the deep areas. Oil companies are continually increasing their holdings. This adds to the overhead and when added to the costs of production the total mounts up. It is very difficult to estimate what it does cost to produce a barrel of oil. The costs

vary from field to field, from well to well, and from time to time. It is practically impossible to take an average of what it does cost to produce a barrel of oil. Furthermore, the life of the well varies from field to field and sand to sand. The costs must be distributed over the life of the well.

The following illustration shows how the total cost of production varies. According to *The Lamp,* of the Standard Oil Company of New Jersey, it is estimated that the first 200,000,000 barrels of oil to come from the 15,000 acres which are produced in the Yates field, Pecos county, Texas, will be obtained from not more than three hundred and seventy-five wells at a total cost of less than twenty cents the barrel. The same authority states that the record of Seminole, in Oklahoma, to January 1, 1929, shows more than 2,300 wells had been drilled on a little more than 20,000 acres to produce 300,000,000 barrels of oil at a cost of $1.00 a barrel, more than the estimated unit cost of the first 200,000,000 barrels from the Yates field. Mexia, in Texas, produced up to January 1, 1929, from 3,700 acres through 700 wells at a cost of about eighty cents the barrel.[23] The average cost of production from these wells will increase as production declines and lifting costs the barrel increase.

Low prices have one wholesome effect on the industry that high prices do not. In periods of low prices efficiency increases and there is not the reckless waste that often occurs when prices are high. On the other hand, high prices make it profitable to keep up small wells that would otherwise have to shut down if operated very long at a loss. These small wells cannot be taken off the pump when prices are low and when prices are high put back on the pump again. In one sense a small oil well is like a cow. A cow to give milk over an extended period of time must be milked regularly. Similarly, an oil well to produce over an extended period of time must be pumped regularly.

W. H. Gray, formerly president of the National Association of Independent Oil Producers, in his testimony before the senate subcommittee of the committee on manufactures very clearly brought out the reason why small wells must be pumped regularly.

> It is a little difficult to explain, but all old wells produce a little water. They will pump better if they produce it. If they do not, the paraffine becomes caked up in it, and it rapidly seals up in there, and they produce nothing. If you let them stand, that water accumulates in that hole, and it becomes perfectly dead. The gas does not come through at all. The water will gradually rise in that pipe, and if you let them stand there, we will say, for a month or two months, when you go back there, there will probably be two or three hundred feet of water in that hole. That weight of water is down there just killing out the life of that gas. It has come in, filling the crevices where the oil comes through the sand, so that when you go back you have nothing. The oil will never come back anymore. You have to work that well. It has to be worked just like a clock. It has to be

23. "What Price Competition?" *The Lamp,* June, 1929, p. 9.

pumped regularly. Your men have to learn the history of these wells and how they are pumped the best. Sometimes you can pump a well every other day and it will do better than if you pump it every day; but it is absolutely the most damaging thing in the world to let one of those wells sit for a month. I have had a half-dozen of them absolutely ruined in the last two years, just by neglect of that character.[24]

The Gasoline Basis of the Industry

For many years after the discovery of the first well by Drake in 1859 the oil industry was on a kerosene basis. The demand for kerosene governed the demand for crude oil. With the advent of the automobile the industry changed from a kerosene basis to a gasoline basis. Accordingly the demand for gasoline governed the demand for crude oil. The industry is yet on a gasoline basis but there are factors that must be considered that have altered the situation considerably.

The first refineries took off only a small fraction of the gasoline content as compared to modern refinery practice. The skimming and topping plants were the first type of refineries used. For this type of plant the oil with the highest gasoline content, or the oil with the highest gravity, was the most desired. But when the cracking plant was brought into common use the demand changed. Low gravity oils and oil that was formerly used only for fuel oil was bought and run through the cracking plants thus increasing the supply of gasoline without increasing the supply of crude oil. In other words, with the addition of the cracking plant, new sources of gasoline were tapped which had the same effect on the market as bringing in new supplies of crude oil. The increase in natural gasoline, gasoline condensed from natural gas, and blended with heavier fractions to make a merchantable product has also increased the supply of gasoline. In 1929, 27,700,000 gallons were blended at plants as compared to 26,700,000 in 1928 according to preliminary figures of the bureau of mines. Naturally, these influences keep down the price of crude oil. If it had not been for the fact that the demand for gasoline has increased in large proportion since 1920 the crude oil market would be more demoralized than it has been in the succeeding years. With more gasoline being extracted from a barrel of crude than formerly forty-four per cent in 1929, compared to forty-one per cent in 1927,[25] and the production of crude oil being increased at the same time the price of this raw material has been held down to the place where it could compete with coal as a fuel for heating and steam raising purposes. When the price of coal is high and the price of oil is low the tendency is to use crude oil for fuel purposes thus forcing this

24. Testimony of W. H. Gray before the subcommittee of the committee on manufactures of the United States senate, 1922, *High Cost of Gasoline and Other Petroleum Products,* Vol. I, p. 594.

25. United States bureau of mines, preliminary report, 1929.

product in competition with coal. Some writers in the oil trade journals frequently refer to the price of petroleum being on a coal basis, or in other words say that the price of coal will determine the price of petroleum. When coal is cheaper than oil coal will be used and when there is an oversupply of petroleum the price will have a tendency to follow coal. When there is a scarcity of petroleum the upward trend of its price will have a tendency to raise the price of coal, if coal is cheap.

Crude is commonly used for fuel in many places where oil is cheaper than coal. Crude oil has been used in California for a quarter of a century as the principal fuel because it is less expensive. No coal is mined in California and what coal is used must be shipped in from other states.

As the demand for gasoline grew it became less practical to permit the use of raw crude as fuel oil except the very heavy crudes, particularly the crudes imported from Mexico. Oil was run through refineries, the lighter fractions taken off and the residue was then disposed of as fuel oil.

The principle underlying the refining of petroleum is very simple. Crude oil is run into large stills where intense heat is applied. The lighter oils go off in vaporized form to be condensed in coils and come off as gasoline, kerosene, naphtha, etc. The heavier fractions remain and are disposed of as fuel oil. Formerly it was a problem for refineries to dispose of it.

For more than a decade the demand for gasoline increased faster than the supply of crude oil. The situation might have become acute but for the invention of the cracking process which was placed on a commercial basis about 1912. Heretofore the refining of oil had been a physical process. Now more gasoline was made possible by subjecting the heavy oil to intense heat and pressure. The extraction of gasoline through this new process is brought about through chemical action. Where only approximately thirty per cent of the crude oil could be converted into gasoline by the older methods as much as sixty per cent can be realized through the cracking process. Fuel oil found a new use. A new source of gasoline was discovered and it might be said when the cracking process was invented the price of crude was taken off the gasoline, and placed on a fuel oil basis. According to the United States bureau of mines in 1927, 59.6 per cent of the gasoline manufactured was produced by straight-run methods, 30.7 per cent was produced by cracking, and 9.7 per cent from the use of natural gasoline.[26]

Use of Crude Oil as Fuel

According to *The Oil and Gas Journal*[27] in 1917 the recovery of fuel oil

26. United States bureau of mines, *Petroleum Refinery Statistics,* 1927, Bulletin 297 (1929) p. 4.

27. C. O. Wilson, "Percentages of Gasoline Increase," *The Oil and Gas Journal,* June 4, 1925.

from crude reached its highest percentage when 51.03 per cent of all the crude oil run to stills became fuel oil. In 1928 the recovery of gas and fuel oil from the crude processed was 46.8 per cent as compared to 47.4 per cent in 1927. This decline was due mainly to cracking. Stocks of gas oil and fuel oil east of California showed comparatively little change in 1928, which in conjunction with the increase in output, would indicate a small increase in consumption over 1927. Stocks of heavy crude and fuel oil in California increased over 5,000,000 barrels in 1928 as preference was given to light crudes for refining purposes.[28] The increase in the use of hydro-electric power in California probably had something to do with the increase in stocks of fuel oil in that region.

An idea of the importance of the use of fuel oil and its influence on the demand for crude oil may be obtained in Table X.

TABLE X**

National Distribution of Gas Oil and Fuel Oil in the United States, 1926-1928. (In barrels of forty-two gallons each)

Uses	1926	1927	1928
Railroads	72,217,652	69,847,778	70,694,754
Steamships (including tankers)	79,287,605	88,215,028	86,585,673
Gas and electric power plants	33,651,513	30,021,410	30,505,943
Smelters and mines	8,951,817	6,831,275	7,020,976
Iron and steel products	16,102,458	18,335,830	19,180,303
Chemicals and allied industries*		2,080,507	3,494,922
Automotive industries	1,603,393	1,686,605	2,212,495
Textiles and their products*		4,852,204	4,586,306
Paper and wood pulp*		3,131,043	2,792,752
Logging and lumbering	3,183,597	2,370,449	2,578,133
Cement and lime plants	5,586,144	5,051,051	5,223,887
Ceramic industries	3,216,850	3,270,036	2,878,531
Food industries	7,674,766	7,151,361	6,485,226
Other manufacturing	23,017,235	11,130,809	10,030,960
Commercial heating	13,874,181	15,750,506	16,704,335
Domestic heating	2,905,401	5,233,745	5,667,027
U. S. Navy, Army transports, etc.	6,541,638	6,505,869	6,814,501
Used as fuel by oil companies	48,701,023	43,452,584	50,037,039
Miscelleaneous uses	7,514,599	9,353,849	12,757,596
TOTAL domestic deliveries	334,029,872	334,271,939	346,251,359
Exports and other shipments	38,620,895	47,390,862	44,428,543
TOTAL distribution	372,650,767	381,662,801	390,679,902

*Deliveries to chemical and allied industries, textiles and their products, and paper and wood pulp were included under "Other manufacturing" in the 1926 survey.

**E. B. Swanson, *National Survey of Fuel Oil Distribution, 1928*, A report of the bureau of mines, printed by the American Petroleum Institute, December, 1929, p. 19.

W. C. Teagle, president of the Standard Oil Company of New Jersey in his address before the federal oil conservation board, February 10, 1926,

28. Bureau of mines, "Petroleum, Petroleum Products, and Natural Gasoline," 1928, final summary, mimeograph.

said that two other factors must be considered besides the increase in the price of fuel oil resulting from restricted production:

First, whether economical use of the raw material, crude oil, is not being attained under existing conditions, and, second, whether, an attempt to change existing conditions by new laws and practices will not raise prices of gasoline and fuel oil unduly and thus make the cost to the consumer of the limitations on use out of proportion to the advantage the public derives therefrom.

Not only is fuel oil a competitor to coal but in a sense it is also a competitor with crude oil. Gasoline can be produced on a large scale as cheaply from fuel oil as it can from crude oil thus holding down the price of all three. As Mr. Teagle said later on in his address:

Refinery operations over the past three years are illustrative of the economic tendency I have described. Gasoline was produced more cheaply from cracking than from the initial distillation of the crude, and in this way, by utilizing only distillates 144,000,000 barrels of cracked gasoline were produced. To have produced this 144,000,000 barrels of cracked gasoline from the initial distillation of the crude, on the basis of the average yield reported by the bureau of mines, would have necessitated the running of 565,000,000 barrels of crude. Thus the cracking process during the past three years actually conserved this 565,000,000 barrels of crude which is in excess of the total quantity of crude now in storage in the United States.

His conclusions are that the existence of cracking processes and the relatively low price of fuel oil are safeguards against the uneconomical use of crude resources.

The inevitable conclusion would seem to be that the conservation of petroleum to meet the demands of the future depends upon price.[29]

Hydrogenation

A new method of refining, now in the experimental stage, bids fair to alter the present situation. This new method, known as the hydrogenation process, is not intended to supplant but to supplement, present methods. The process is in strong hands and therefore, it is not likely that it will prove to be an influence working against stabilization.

There are more than 400,000 existing compounds of carbon. Petroleum is a mixture of several of these compounds. Hydrogenation is a synthetic, secret process by which desired compounds may be made. It is intended that by this process gasoline may be made more cheaply and also out of compounds heretofore not suitable for gasoline manufacture.

E. B. Lyman writing in the April, 1930, *The Lamp,* describes the steps:

1. Under the influence of the catalyst, pressure and heat, the hydrogen molecule is split into atoms, ready to unite with the hydrocarbon groups in the oil.

2. In much the same way the hydrocarbon molecules are likewise split open, somewhat as in the cracking process.

29. W. C. Teagle, "A Big Step toward Conservation," *The Lamp,* February, 1926, p. 9.

3. The hydrogen atoms immediately hook up with the hydrocarbon groups and the molecules "close up" again so to speak.

The process was worked out by German chemists and has followed, perhaps logically, the hydrogention (addition of hydrogen) of coal to produce oil. The patent rights are owned by the Standard Oil Company of New Jersey and I. G. Farbenindustrie Aktiengesellschaft of Germany through a holding company known as the Standard-I. G. Company. The patents for the United States are controlled by the Hydro Patents Company, a subsidiary of the Standard-I. G. Company. The Standard-I. G. Company also controls the patents in other countries through other subsidiaries.

The shares of the Hydro Patents Company are held by seventeen large refining companies in the United States controlling approximately sixty-six and two-thirds per cent of the total daily crude running capacity in this country, and about eighty per cent of the refining capacities of the United States potentially available for the adoption of the hydrogenation method.

According to *The Oil and Gas Journal* the share holdings of all these companies, including the Standard Oil Company of New Jersey, are in proportion to their crude running capacities, with a minimum holding of five hundred shares. Control of these patent rights within the United States therefore passes to the prospective users of the process.

The first commercial plant for the hydrogenation of petroleum products ever completed was placed in operation at the Bayway, New Jersey, refinery of the Standard Oil Company of New Jersey in the summer of 1930. This plant which has a normal charging capacity of 5,000 barrels daily is an experiment. Two more plants of similar design are expected to be completed later.

The effect of this process on the conservation movement is outlined in a statement issued by the Standard Oil Company of New Jersey:

> Interview of the direct bearing of the hydrogenation process upon the question of conservation of oil supplies, and its effect of lifting the average quality level of gasoline, kerosene, lubricating oil, fuel oil, Diesel oil and other petroleum products, it may be safely assumed that the policy of the company will be dictated by the interests of the industry in general.

Price Variation Between Areas

It was pointed out in a previous chapter that petroleum is found in widely scattered areas throughout the United States. The prices paid for oil in the various sections are by no means uniform. However, there is a fair degree of harmony existing in their price movements.

There are several reasons why there is such a wide range of prices. In the first place Pennsylvania crude brings a high price because it is nearer the larger refineries on the Atlantic seaboard. The Pennsylvania oils have also

a very high gasoline content and are much desired for that reason. Many lubricating oil and grease manufacturers prefer Pennsylvania oils for their purposes and are willing to pay a higher price for them.

Oil from the Lima fields is not as good as that from the Pennsylvania fields but it is nearer the eastern refining centers and brings a higher average price than does the oil from the Mid-Continent fields, although it is no better. Gulf coast oil has a very low gravity and a low gasoline content, consequently it brings a much lower price than does the oil from the Mid-Continent although the Gulf Coast oils are much nearer the larger refineries on the Gulf coast with the exception of that part of the Mid-Continent field that extends down into Texas. A large part of the California oil has an asphalt base. It is far from the eastern consuming centers also. California is able to meet the demands of the Pacific coast market and have a considerable surplus left over. This surplus, with the exception of the part that is sold in foreign markets is brought through the Panama Canal and sold in competition with oil from the interior of the United States. In 1923 for the first time the large production from this area brought down prices of petroleum in all sections of the United States. It is cheaper to transport oil with tank steamers than it is through pipelines. The better grades bring prices comparable to those of the Mid-Continent field. The oils from some fields, particularly in west Texas, have a larger sulphur content. The presence of sulphur is very undesirable in refining for technical reasons, therefore, the prices of these crudes are comparatively low.

The small refiner is more concerned over the price movements of crude petroleum than any other group of purchasers because price changes affect his business most. It was stated in a previous paragraph that the bulk of the crude oil sold by independent producers is sold to the large purchasing companies. The independent producer prefers to sell to the large purchasing companies because they can offer better service and most likely take their oil in any and all conditions of the market. Most of the small refiners depend on a special grade of crude, usually those grades with high gasoline content, for the operation of their plants. If they bought their oil from the large purchasing companies they would have to buy the average grade that is run through the pipelines because in these lines all grades are mixed. In order to get the kind of product best suited for their needs they are forced to pay a premium. That is, they are forced to pay a premium when there is a brisk demand. They usually receive their supplies in tank cars. On the other hand when the market is depressed and there is an oversupply of crude these refiners can go into the open market and buy their raw material at prices lower than the posted price. Being able, therefore, to buy good oil at prices lower than the posted price they are in a position to make cheaper gasoline than can many of the larger refiners and it

is this type of refiner that disturbs the gasoline market for the larger companies in periods of depression.

When the consumption of crude oil begins to approach nearer production and it is necessary for the large companies to draw on storage to meet the demand the small refiners then have to pay a premium for their supplies. This condition will go on for awhile because prices are tightening and advances are being made gradually. But after awhile their stocks begin to get so low that they are forced to bid the price up to get their oil. Then the small refiners are forced to meet the increase and offer a bonus on top of that in order to satisfy their needs. This condition continues until production is increased again and the supply overtakes the demand.

Theory of Value Regarding Petroleum

At this point it is appropriate to formulate a theory of value in regard to petroleum and petroleum products. In spite of the fact that there is an abundance of petroleum, at the present time the resource is limited. No one knows when the production curve will begin the descending scale. We know that every barrel taken leaves one barrel less beneath the ground. The most conservative thinker does not believe that the resource will be cut off suddenly. When the decline comes it will be gradual. Petroleum will be produced for years to come.

At the present time there are no substitutes for petroleum that can be produced cheaply enough and in large enough quantities to compete with it. Consequently petroleum is being consumed today to the degree that our present wants are more important than future wants. However, the products of an exhaustible resource should not sell for less than its substitute. Substitutes may be found today in shale oil, coal and lignites, and from agricultural products.

The public has been accustomed to cheap motor fuel for so long a time it would not consent for the government or any one else to raise the price of motor fuel arbitrarily to the price of substitutes. Since it is a matter of public interest the government should appropriate sufficient funds for research to find a substitute that would sell within the price range of motor fuel today.

In the interest of stabilization and conservation the price of crude petroleum should be maintained at a high level. What is understood here to be a high level is a price high enough to justify the operators a reasonable profit and at the same time be high enough to eliminate the unessential uses to which petroleum is now placed. Instead of the industry striving to seek new uses for new markets let the price be high enough to justify the uses to which it is now placed. Considerable oil is now burned under boilers that could be diverted to higher uses if the price justified it. An unessential use is the utilization of

petroleum in the place of a satisfactory substitute. The price should be high enough to take petroleum out of competition with coal.

The argument for high prices of petroleum does not preclude monopoly prices. Ordinarily monopolies of natural resources sell too cheaply because high prices would create substitutes. Monopolies also sell too cheaply because prices must be fixed to secure large present profits. A monopoly of the petroleum industry could not make large profits with high prices because of the lessened demand and the use of substitutes. A monopoly of petroleum production must maintain prices at a low figure because incomes accruing in the future will of necessity have to be discounted greatly. Petroleum products are put on the market as rapidly as possible because it is not a very good investment to hold them any number of years. This is as true for the individual operator as it is for the monopoly. It is an axiom that the further away an income is the less is its present worth. A thousand dollars fifty years from today is worth less than a thousand dollars twenty-five years hence. A thousand dollars due ten years from today has a present worth greater than a thousand dollars due twenty-five years from now. Therefore, it is to the interest of any operator, individual or monopolistic, to secure the greater return in the minimum of time.

Business men in all industries want stabilized prices. It is a goal they are all striving to reach because a stabilized price gives assurance and definiteness to business activity. Where there is no free competition and prices are under monopoly control it is an easy matter to stabilize prices. But even under a condition of free competition the tendency is toward price stabilization. That tendency is seen in the oil industry. There are many legal restrictions, both state and national, to co-operative price fixing, but, regardless of these restrictions business men bend their efforts toward stabilizing prices.

In the oil industry stable prices are sought through co-operative efforts of producers. So far little headway has been made in this direction. Some producers will consent to restrict drilling activities. Wells are pinched in and actual drilling stopped on others yet unfinished. But in spite of all this there will be a few who will not co-operate and they may have good reasons for not doing so. They should not be condemned for not entering into these agreements. The public has insisted on free competition in the oil industry and its desire has been granted. The industry has insisted on its right to private property and its rights have been recognized by the government. Both should be satisfied but neither is. Many plans have been suggested but the industry has failed to agree. The problem is not yet solved. But that is no reason that it cannot be. Concessions must be made by all parties interested. Suggested solutions to the problem of price stabilization will be discussed in subsequent chapters.

CHAPTER SEVEN

STABILIZATION EFFORTS OF THE INDUSTRY

THE preceding chapters pointed out the forces that have worked against stabilization. This chapter will discuss the forces for stabilization. The succeeding ones will be devoted to a discussion of the details of the plans and efforts that have been made to bring stabilization about. The principal factors that have worked against stabilization, it was shown, are the institution of property rights, the transitory nature of oil and gas, the competitive system, the fear of an early exhaustion of the supply, the natural acquisitiveness of man, and state and federal legislation that forced production on public lands.

One factor standing in the way of stabilization mentioned only indirectly in previous chapters is the overcapitalization of the industry. Too much money has been invested in the industry. The pressure to pay dividends has forced executives to follow policies that would not otherwise have been followed had this pressure not been present. It has been estimated that there is between $10,500,000,000 and $11,300,000,000 invested in all branches of the industry. This condition may not be peculiar to this business alone. Nor is it implied that all units are over capitalized. The pressure, however, of the owners of the ten and one half billion dollars for dividends has brought about a condition of overproduction in the producing, refining, and marketing branches of the industry. The ownership of this investment is distributed among thousands of people scattered throughout the United States and foreign countries. The way to make money out of oil is to produce, transport, refine, and market it. This is the goal of all those in each branch of the industry. While some units have always made money, some have come out even, others have failed. The net gain to the industry has been reduced by an oversupply. The industry is affected because profits have been reduced. Society has been affected because an exhaustible resource has been forced, through overproduction, into minor uses.

The problem of stabilization may seem to some to be a recent thing; a cloud that has appeared on the horizon since the war. As a matter of fact, it has appeared in different guises almost since the very beginning of the industry.

Efforts to Restrict Production

Colonel Patrick C. Boyle, proprietor and publisher of the *Oil City Derrick* and the late founder of *The Oil and Gas Journal,* in his testimony before the United States industrial commission,[1] September 6, 1899, brought out some

1. Industrial commission report on trusts, 1900, Vol. 1, pp. 426-463.

illuminating facts. Within a decade after Drake drilled the first well there was a condition of overproduction. Colonel Boyle in his testimony said that by overproduction he meant more oil was being produced than could be consumed at the time at remunerative prices. The Petroleum Producers' Association was organized in 1869 to meet this condition. There was an effort in 1873 on the part of the producers in Clarion county, Pennsylvania, to shut down because the large volume of oil being produced was causing the operators to suffer loss. This movement was only local in its influence. A plan was started in 1876 for pooling the surplus oil as a means of advancing the market. Conditions improved so rapidly by midsummer of that year that this scheme became unnecessary. Oil advanced to four dollars a barrel. This advance attracted so much new capital into the industry that for a decade following there was a depression. A new pool was brought in at Bullion which added in two years 3,000,000 barrels of oil to the supply. Bradford soon followed and Colonel Boyle said its influence was felt for a quarter of a century afterward.

There were other local movements directed toward restricting production. David Armstrong, in 1877, organized the Producers' Protective Union as a result of the Bullion development on prices. This was a secret and fraternal organization whose purpose was, by uniting their interests and suspending operations, induce their friends and neighbors to join them until they formed an unbroken chain. Between two thousand five hundred and three thousand producers were enrolled as members in the local lodges which sent delegates to the general council.[2]

There was a general, but partly successful, movement in 1884 among the producers to restrict drilling. This movement was the result of the large production from the Thorn creek pool. It failed for lack of co-operation of all the producers interested in that area.

Out of this movement, however, there was one interesting result; this was the formation of the Producers' Associated Oil Company. This company was formed by all the existing producing companies taking some shares. The capital stock was $1,000,000 and the stock was distributed among the producing companies. The purpose of the company was to purchase property in order to curtail production and stop drilling. This company was instrumental in drawing up a drilling contract known as the "boundary-line contract" providing that the members of the association were not to drill a well on any line within a stated distance—that is, closer than would give an area of twenty acres to each well. The aim was to limit production.

At this time there was a surplus of 31,000,000 barrels of oil held in storage above ground by the Standard Oil Company, which was naturally interested in restricting the amount of crude oil being produced. Therefore,

2. Gilbert Holland Montague, *op. cit.*, p. 67.

it entered into an agreement with the Producers' Association to suspend active drilling operations and to restrict its production at least one-third for the period of a year, on turning over 5,000,000 barrels of oil to the latter.

When this agreement was made the price of oil was seventy-one cents a barrel. This agreement advanced the price of crude oil twenty-nine cents a barrel.

There was another part of this agreement that is interesting in that very few, if any, agreements since then have contained this feature. The total consideration was 6,000,000 barrels. Out of this total 5,000,000 barrels went to the producers. It was agreed that the Standard Oil Company and the Producers' Association would then give 2,000,000 barrels of oil, 1,000,000 barrels each, to the laborers affected by the shut down as compensation for the loss of employment. The oil was sold and distributed to the laborers through their organization. According to Colonel Boyle's testimony the laborers benefited more by this shut-down than had they worked. He estimated that the average driller worked two hundred days a year and earned a $1,000. There were eight hundred fewer wells drilled during the year of the shut-down than during the previous year. Estimating that the same number of wells would have been drilled had there been no shut-down, the laborers profited by the transaction. At this time there was considerable activity in the Ohio fields and many of the floating workers went there and found work.

After 1900 drilling activities spread to other parts of the United States. Industry was so scattered that little community of action was obtained as far as curtailment of production is concerned until after the World War.

One futile effort was made by the corporation commission of Oklahoma to restrict production in the Cushing pool in 1914.[3] This pool reached its peak of daily production in May, 1915, with a production of 305,000 barrels. At the instance of the attorney general the corporation commission put into effect the order appointing W. W. Watts as umpire to regulate production. One producer was brought into court for violating the order. The case was tried in the district court at Tulsa and the stand of the producer was upheld. The effect of this decision was to delay the conservation movement in Oklahoma approximately a decade.

The criticism might be offered that there is no relationship between the movements to curb production in the previous century and the efforts today. That the technique is different there is not a question of a doubt. That the sanction of government was obtained in the early movements no one contends. The nearest approach to a scientific basis of production was the boundary line contract. At that time the industry leaned very little on science. The early operators were not concerned much with conservation. But there was

3. Edwin L. Reeser, *Oil Royalties*, Dexter Publishing Co., Tulsa, 1929, p. 67.

one thing that the early producers did have in common with modern producers in their efforts to curb production and that was profits. Call it conservation, or any thing else, there would be very little interest in the movement today if the operators did not think it would bring larger profits in the end.

In an economic system such as the one prevailing today no study of stabilization can be undertaken without a consideration of profits. The profit motive is the underlying force in the economic set-up. Stabilization does not mean the guarantee or assurance of profits. Stabilization means the elimination of those forces that bring depression and wide bulges of prosperity. It means the placing of the industry on an even keel. It means the adjustment of production to consumption, the correlation of supply with demand at a price that will bring a reasonable profit.

That stabilization can be achieved will be discussed in a subsequent chapter. That it is a goal worthy of an effort most economists will agree. Attention now will be given to the development of the modern stabilization movement. The leaders of this movement refer to it in terms of conservation. In all fairness to these leaders let us say that they are interested and sincere in promoting conservation. Conservation is only one aspect of stabilization, however, and it is stabilization in which the industry is most interested.

Modern Movement for Stabilization

The modern movement for stabilization began about the year 1918. Chester C. Gilbert and Joseph E. Pogue published a report for the United States national museum, *Bulletin 102* in 1918 in which they called attention to the dangers and economic evils of overproduction. They expressed the opinion that the fundamental difficulty with the practices of production lie in the competitive development of pools which should be treated as geological units. They recommended an integration of operations in so far as it was possible without having monopolistic control.

There was very little interest on the part of the general industry in the problem due to the existing prosperity which came to an end at the close of 1920. The industry had contributed no small part to the success of the War and had met all the demands made upon it. There was so much general satisfaction with what had been done that there was little thought placed on the future.

An organization was born in 1919 that has been one of the most potent influences in this direction, if not the most influential. It is the American Petroleum Institute and was the outgrowth of the national war service petroleum committee. At the time of its formation M. L. Requa, director of the oil division of the United States fuel administration said:[4]

4. *Oildom*, April, 1919.

The tremendously increasing demands for petroleum, focusing on an ever-increasing domestic consumption and calling for an increasing draft on the oil pools of Mexico and South America, create problems of the first magnitude that will crowd forward with growing weight in the next few years. The pressure of these circumstances, in view of the extremely intricate character of the entire petroleum activity, demand machinery for bringing a higher degree of scientific oversight and efficiency as a whole than is possible under present conditions. So insistent, indeed, is this necessity conceived to be, that governmental action will ultimately be forced by the dictates of circumstances, if the industry does not anticipate the matter and give to the situation the co-operative help that is even now so distinctly needed. . . . production has its problems that need a representative organization to solve—problems in co-operation, in development of engineering practice, in the securing of adequate state and national legislation. . . . . .

The producer of petroleum is after all a trustee administering a wasting asset in behalf of the population as a whole. Deliberate waste and inefficient handling of the product should no more be tolerated by the industry *en masse*, than we would tolerate railway rebates and other odious forms of special privilege.

There should be intensive and constructive investigations undertaken in an effort to determine what may be done that will more efficiently administer the trust. And I know of nobody so well equipped to undertake this work as the producers themselves, acting as a section of the Petroleum Institute. I do not pretend to say what the answer is, but that the question must be answered I am sure; and if not by the industry itself in co-operation with the government, then by the government alone.

Please do not misunderstand my meaning. I am not making this statement as a threat: I am only attempting to point out the logical sequence of events following in the train of increasing demand for our most important raw material. I am quite well aware that past generations must have looked upon the proposal as extreme socialism, if nothing worse; but I have also in mind the fact that a barrel of oil once produced is not replaced in the earth, that our consumption has grown far beyond preconceived ideas, and that we face an era of still greater consumption.

Beginning with 1919 government officials, scientists, and leaders in the industry made statements from time to time on the importance of controlling the production of petroleum. These statements stand out prominently because there was little effort, taking the industry as a whole, along this line. Franklin K. Lane, secretary of the interior, in his report for 1919 urged a rigid policy of saving.[5] In February, 1920 at the meeting of the American Institute of mining and Metallurgical Engineers, Director Van H. Manning of the United States bureau of mines, Dr. George Otis Smith, director of the United States geological survey, J. O. Lewis, chief petroleum technologist of the bureau of mines, read papers in which they emphasized the inadequacy of the visible supply of petroleum in proportion to our needs, the importance of conservation, better engineering practices, and discussed the situation in regard to possible supplies from foreign fields.

These discussions and the rise in price of petroleum and petroleum prod-

5. Reprinted as a bulletin of the United States geological survey, No. 705.

ucts attracted the attention of congress. The federal trade commission was directed by congressional resolution in 1920 to make

inquiry and investigation into the causes of the recent advances in the price of fuel oil, kerosene, gasoline, and other petroleum products, and report to the house not later than June 1, 1920;

and to

take into consideration and to report the sources of oil supply for the United States and the profits of said business, and what, if any, conbinations in restraint of trade exist between those engaged in business, and what effect, if any, the same have upon the market price of fuel oil, kerosene, gasoline, and other petroleum products to the ultimate consumer.

The report of the federal trade commission in response to this resolution was published as house document, 801, in 1920. The summary of the findings of this commission are as follows:

1. It seems that there is greater justification in assigning the advance in price of crude oil and petroleum products to varying conditions of supply and demand in the light of emphasized and pessimistic statements as to future supply than to a combination in restraint of trade. . . .

2. It is probably true that the recent advances in the price of petroleum products—have been due primarily to the strong demand for such products, coupled with the difficulty of many companies in getting adequate supplies of crude oil, the increased prices thereof and the increase in other expenses of operation.

3. The explanation of the men in the oil industry regarding the reasons for the advances in the prices of crude oil—namely, the strong demand for crude oil, the decline in stock, the increasing consumption during the last half of 1919, and the decreasing production during the last quarter of 1919, the increased cost of drilling and producing crude oil and the unfavorable developments in the Mexican oil field—has substantial force. . . .

The suggestions of the commission dealt with the securing of foreign supplies, the possibility of congress limiting the exportation of domestic crude oil and its products, the prevention of wastes in production, improved methods of utilization, the study of availability of substitutes, and the collection of full information concerning the industrial and commercial conditions of the industry.

The tabulated data of the report showed that the tankwagon price of kerosene varied from 9.5 cents to 15.5 cents a gallon in different sections of the United States, on January 1, 1919; that it had risen gradually during 1919, and rapidly during the early part of 1920 from 13.5 to 22.5 cents a gallon for May 24, 1920; the tank wagon price of gasoline was from 20.5 cents to 25.5 cents the gallon on June 1, 1919, and from 23.5 cents to 31.0 cents the gallon on May 24, 1920; while, during approximately the same period, Mid-Continent crude had increased from $2.25 to $2.50 a barrel; Pennsylvania crude, from $4.00 to $6.10; Gulf coast crude, from $1.00 to $3.00 and California light crude from $1.30 to $1.76.

These high prices for crude continued through 1920. During the latter part of the year, however, production overtook consumption but it had not be-

come impressive until the very end of the year and the addresses at the first annual meeting of the American Petroleum Institute,[6] so far as they dealt with the problem of conservation were in the nature of further warnings of the necessity of conservation on the one hand and of reassurances as to continuing supply and the lack of necessity for conservation measures by the more "practically" minded.

At this meeting Mr. Teagle said in his address:

. . . . The United States is now spending its petroleum wealth for the world's benefit, in order to meet seventy per cent of the world's present demand.

Americans have done this primarily because they had the most accessible oil and the facilities for refining and distributing it. Is it reasonable, however, to ask that they go heedlessly on to the quick exhaustion of their supply, and then retire from the oil business?

The American petroleum industry cannot accept such a conclusion. On the contrary, it must look to the development of supply outside the United States to supplement the supply from domestic fields. Domestic crude supply is not sufficient for even current home needs, and it is absolutely imperative that American petroleum producers proceed actively and intelligently to develop oil resources in foreign lands. . . .

George Otis Smith again called attention to the rapid rate of depletion of the petroleum reserves of the United States, the dependence on imports and the necessity for conservation.

Plainly, the common interest in a limited resource is not served simply by regulation of price . . . . The danger that lies in cheapness is the wastefulness of today that will lead to the consequent scarcity and corresponding high prices of tomorrow. Wise action therefore, in behalf of this and other generations does not include the encouragement of small units in production, simply to provide competition, where larger units are more efficient and economical; that makes possible a large utilization of natural resource. . . .

The application of these principles to the petroleum problem is obvious. Our plans for the future must include every possible economy in the handling of this limited resource of unlimited usefulness. We should exercise economy in the development of the resource by avoiding all the wastes of the past and present, wastes largely inherent in the small unit system of operation, with competition and mismanagement running wild. There should be economy in use; the whole of the petroleum ought to be used and each part put to its highest use, a purpose that is not easily attained but that should be clearly set forth and publicly accepted. . . .

I believe that production of the United States will be entirely governed by the price paid for crude oil, for a longer period than anyone, no matter how learned, can safely predict; and I will close as I began, by voicing my father's belief that kind providence never limits the supply of anything so valuable as petroleum. To this I add only that price will bring production, and that territory still unknown will be found to meet the needs of future generations as they arise.

In his address on "Production—the Future," Thomas A. O'Donnell said:

The public has been frequently alarmed by statements of well-meaning and learned scientists predicting an early exhaustion of our petroleum resources. . . .There are many important petroleum resources even within the boundaries of the United States that these men have not yet located or taken into their calculations. Petroleum is widely distributed throughout the world, and, I believe, in sufficient quantities to meet the requirements, pre-

6. Bulletin of the American Petroleum Institute, No. 132, 1920.

ent and future, and if the economic law of supply and demand is given a free opportunity to assert itself, artificial political and governmental restrictions are removed, allowing everybody from everywhere to participate in the prospecting and production necessary, there will be plenty of oil to meet the requirements in all parts of the world for generations to come. An assurance, however, of stable property rights and private ownership is necessary to encourage the prospector, with his vision of wealth, to get busy. . . . . .

There has been a great deal of agitation in the United States in the name of conservation for state and national regulation to prevent waste; there have been many ridiculous statements made by men connected with government departments and other scientists as to the enormous waste which has occurred in the petroleum industry because of lack of regulation. . . .

I have always resented the statements that the development of the petroleum industry has been unnecessarily wasteful. I do not think the petroleum industry, as a whole, has anything to apologize for along this line.

Henry L. Doherty, in an address on the "Future of the Oil Business" stated his belief in a continuing supply of motor fuel which he distinguished from the supply of petroleum, as also between the possible demand for petroleum and the demand for superior uses.

M. L. Requa in an address on "Conservation," stressed the necessity for conservation through co-operation within the industry in view of the imminent danger of government regulation in the failure of such co-operation. His remarks on this subject were in the same tenor as those in his address delivered at the founding of the Institute in 1919 which were quoted previously.

The overproduction which began in 1920 had reached such a stage by the end of the year that in December the Prairie Oil and Gas Company was prorating runs in the Mid-Continent field, taking only seventy per cent of the production to which its lines were connected.

During 1921, there was a rapidly increasing domestic production which, in spite of greatly increased demand, forced much oil into storage and resulted in a drop in the price of Mid-Continent crude from $3.50 a barrel in January to $1.00 a barrel in July followed by a rise to $2.00 a barrel by the end of the year. These conditions coupled with a severe general business depression made the year a very unsatisfactory one for the petroleum industry.[7]

One of the principal forces contributing to the oversupply of oil was the importation of crude from Mexico. During 1920 there were imported into the United States from this country 106,175,000 barrels. In the first five months of 1921, 55,600,000 barrels were received. In order to check this flow of foreign oil in competition with domestic production the independent producers throughout the country started an agitation for a tariff. A brief and argument was prepared by all the independent oil producing associations of the United States and submitted to congress. No relief, however, was secured from this source.

7. Manuscript of L. C. Snider, H. L. Doherty and Company, New York.

There was a lack of co-ordination between the prices of refined and crude products in 1921 due to the disordered business conditions which grew out of the high prices of 1919 and 1920. This condition brought on a great deal of criticism directed at the industry. The press fanned the flames of criticism when in July, 1921, senate resolution 120 was introduced calling for an investigation by the committee of commerce on the causes of the fluctuations in the prices of crude petroleum and its products and in August, the same year, senate resolution 138 was submitted which called upon the federal trade commission to investigate and report to the senate its findings of fact on certain questions regarding the petroleum industry.

Suggestions for stabilizing the industry were prepared for the press by Henry L. Doherty and Company of New York. The following extracts are of interest:

The loss to the oil business, due to instability of price and instability of supply, has unquestionably been stupendous. . . .

Many manufacturers will use an inferior fuel in preference to oil rather than submit to the caprices of price and supply experienced in using oil. A great deal of the ill-will toward the oil companies is due to fluctuations in price. . . .

The history of the oil business has always been one which has fluctuated continually between flood and famine, swinging back and forth irregularly. There is little, if any, appreciation on the part of oil men themselves of what immense benefit would accrue by a greater stabilization.

The business has been developed along lines which makes it perhaps the most highly competitive business of any in existence. This has been accentuated by laws intended to prevent restraint of trade to the detriment of the public, and yet these laws, and the court decisions based on these laws, have really prevented proper and necessary co-operation of the people engaged in the business to enable them to conserve oil for the benefit of the public. . . .

Aside from public regulation of drilling and production of oil and which I am not as yet ready to advocate the greatest step for stabilization would be:

1. Efficient and economical means for storage.
2. Revision of unnecessary restrictive laws, regulations and rules by both the public authorities and insurance companies.
3. Salesmanship of fuel oil on a broad scale. . . .
4. Creation of the means and instruments of credit whereby funds can be raised in large amounts whenever it is necessary to store oil on a huge scale.[8]

A notable contribution to the literature on petroleum economics was the publication in 1919 of *The Economics of Petroleum* by Joseph E. Pogue,[9] consulting engineer. Mr. Pogue states in the preface that,

irrespective of the quantity of recoverable petroleum underground, the output of this country must inevitably decline. This decline, however, may be expected to be a slow recession over a considerable number of years, rather than a sharp and sudden curtailment. The peak of production was possibly reached in June, 1921. That this record will be substantially

8. *Idem.*
9. Joseph E. Pogue, *The Economics of Petroleum,* John Wiley and Sons, Inc., New York, 1921.

bettered is unlikely, although it can doubtless be surpassed if the price of crude petroleum advances sufficiently.

Mr. Pogue said that whether we had passed the peak of production, or not, that it was immaterial. The point to be emphasized is the importance of increasing efficiency in the industry, a problem that concerns all branches of the trade alike.

The economic effects of small unit operation were also stressed by Mr. Pogue. He states that the production of crude petroleum responds quite laggardly to changed conditions being affected mainly in its exploration and drilling stage several months removed from production proper. The decline of output of old wells places a cumulative burden upon oilfield exploitation by the expanding campaign of drilling to replace this reduced output. This burden cannot be borne perpetually. [10]

The second annual meeting of the American Petroleum Institute in December, 1921, [11] paid more attention to the immediate situation in the industry than it did to the problem of conservation in general. President T. A. O'Donnell in his annual address attacked the "super-scientists" and their estimates of petroleum reserves. He also decried any tendency toward governmental control or interest in the industry. He made one suggestion, however, that is being put into practice today and, that is, to formulate agreements to shut down large production pools during the period of seasonal accumulation of stocks. This would prevent the usual waste necessary in carrying oil in storage and at the same time there would be a sufficient supply available during the peak of consumption. He expressed the fear that this would be in violation of the law but efforts should be made to amend the law so that such agreements could be brought about. Mr. O'Donnell felt that a program of this kind would work in the interests of conservation, stabilization, in the interest of the producer and of the public at large.

Harry F. Sinclair in his address, "Looking Ahead," scouted the idea of an early exhaustion of the supply of petroleum. He said: "There is plenty of petroleum and always will be. The exhaustion of the world's supply is a bugaboo."

During 1922, there was a continual increase in the rate of domestic production, stocks increased rapidly during the first part of the year, but the increasing demand produced a balanced condition during the latter part. The price for average Mid-Continent crude was maintained at $2.00 the barrel until past the middle of the year, but declined to $1.25 during August and September and rose to $1.50 in December. As a whole the year was a good one for the petroleum industry, but it was ended with the threat of a great overproduction from the fields in the Los Angeles basin in California, the Burbank

10. *Idem.* p. 47.
11. Bulletin of the American Petroleum Institute, No. 200.

field in Oklahoma and the Powell field in Texas. The year brought out very little discussion of unit and co-operative development or of the conditions underlying these ideas.

At the third annual meeting of the American Petroleum Institute at St. Louis in December, 1922, in his presidential address, Thomas A. O'Donnell was even more outspoken against any form of federal control or regulation than in his previous presidential addresses as is shown by the following brief quotations.[12]

I believe in as few laws as it is possible to have, and those particularly directed to make us be fair to one another, and then give us a free opportunity to scramble and fight it out at home. . . . . There are not enough days in the year for those fellows at Washington to legislate. They are sitting all the time keeping us all confused and in a turmoil trying to pass laws concerning active business life of the country, having the national government do something that could be done at home. . . . .

The thing for you to do at all times is to keep the national government out of it. . . .

Contrary to the views expressed by President O'Donnell, President A. L. Beaty of the Texas Oil Company said that the country was experiencing a period of waste and extravagance; that more oil was being produced than was needed; and that Nature's own reservoir was the place to keep the oil in storage. He stated that he did not agree with those who were opposed to governmental regulation. In regard to excessive drilling and the waste of oil the industry should take the initiative in bringing about effective legislation that would put a stop to these practices.

A. C. Bedford, chairman of the board of the Standard Oil Company of New Jersey, said that while he believed that business should have the freedom to grow and prosper he also agreed that the government has certain proper functions and supervision and regulation. The government has the right to insist that there shall be adequate publicity. Unfair trade practices should be prevented. However, in the matter of policy determination the discretion of government officials should not take the place of the judgment of those experienced in the business.

Federal Investigations of the Industry

The United States senate in June, 1922, adopted a resolution that had an important bearing on the industry. This resolution called for an investigation of the petroleum industry by the committee on manufactures. This committee was ordered to investigate the stocks of crude oil and crude oil products held at refineries and other places in the United States at the end of each month in the years 1920, 1921, and 1922; the prices of crude oil and crude products for the same years; whether or not these price changes were uniform for all companies and if there were local differences; whether there was any natural reason for these changes, or whether there had been any agreements made to raise

12. Bulletin of the American Petroleum Institute, Vol III, No. 62, pp. 2 and 3.

or depress prices; and to ascertain all facts bearing upon the recent changes of crude oil and its products.

This committee was given considerable power to require the attendance of witnesses; to require the production of books, papers, and documents; and to employ counsel, experts, and other assistants. The chairman of the subcommittee designated to carry on this investigation was Senator Robert M. La Follette of Wisconsin. The officers of nineteen of the leading oil companies were examined orally. The testimony of more than fifty witnesses was taken Voluminous records and documents were submitted to the committee.

The report was given to the senate in March, 1923. It was very unfavorable to the industry, particularly in regard to the alleged domination of the industry by the "Standard group" of companies. The tone of the whole report is a marked contrast to the report of the federal trade commission in 1920. Naturally it attracted considerable unfavorable attention to the industry.

The report of the committee was received with great dissatisfaction by the petroleum industry, and was answered by many individuals and by the trade press. One of the leading trade journals,[13] published a special issue, entitled "The Oil Industry's Answer." The consensus of opinion in the industry, was, undoubtedly that the conclusions and recommendations of the committee were not warranted by the data furnished them nor by the circumstances existing. The statement[14] of A. C. Bedford, chairman of the board, Standard Oil Company of New Jersey, in his address before the American Petroleum Institute in December, 1923, probably summarized the feeling of the industry.

During the past year the petroleum industry has been subjected to investigation. The industry has sought to bring to the attention of the senate committee having the investigation in charge all available facts showing its methods of operation. Just before the last congress adjourned the La Follette committee submitted its report following, though I can hardly say based upon, that investigation. The report seemed to many of us foreign to the main body of testimony submitted before the committee but some of us could not but feel that the report might very well have been written before the investigation had taken place.

The Doherty Plan

A great overproduction was clearly indicated during the last part of 1922 but the increase in consumption seems to have attracted more attention. The price for Mid-Continent crude rose from $1.25 a barrel to $2.00 a barrel during the last few months of 1922 and first few months of 1923. The enormous production of the new fields in California, the Powell field in Texas and the Burbank field in Oklahoma soon made itself felt, however, stocks began to accumulate rapidly, and the crude price declined to $1.00 a barrel by the end of the year. The additions to stocks during this year, piled on top of the nearly constant accumulations since the latter part of 1920, severely strained the industry. The California excess production both of crude and refined products found an

13. *The Oil and Gas Journal.*
14. Bulletin of the American Petroleum Institute, Vol. IV, No. 113, p. 56.

easy outlet to the Atlantic coast through the Panama Canal and came into direct competition for the first time with eastern and Mid-Continent products. The price of crude for the greater part of the year was below the cost of production in all except the new gusher fields, and probably below the cost on most leases even in these fields. The continued wide fluctuations in the prices for refined products brought about renewed criticism of the petroleum industry from the press and the public. The report of the senate investigating committee attracted considerable unfavorable attention to the industry. These circumstances and the serious condition within the industry in regard to conservation, future supply, waste, the possibility of governmental regulation or control, and of means of avoiding such periods of acute overproduction, aroused their interest. The principal events of the year in this connection were probably the report of the senatorial investigating committee headed by Senator La Follette of Wisconsin, previously mentioned, and the submission by Henry L. Doherty to the American Petroleum Institute of a unit plan for the operation of oil fields.

While the La Follette investigation had no direct results in the way of governmental regulation of the industry, it impressed on the minds of the leaders the very real possibility of such regulation and the dangers of unfriendly or ill-advised legislation. It was probably more generally recognized than ever before that the industry, through no fault of its own, but through the very nature of the business of oil production, was open to misunderstanding and attack on account of the great fluctuations in visible supply and the consequent wide and rapid changes in prices for both crude and refined petroleum products.

It was at this juncture, and with these facts in mind, that Henry L. Doherty proposed to the executive committee of the American Petroleum Institute two important propositions: First, a plan for co-operative activity by the entire industry to further the expansion of the use of petroleum products in new fields and second, a plan for the operation of oil pools as units, which has become generally known as the "Doherty plan".

Before proposing the unit plan of operation of oil pools, Mr. Doherty had endeavored to solve the problem of the instability of the petroleum industry by other methods. His first idea was to increase and equalize the demand for petroleum by increasing its utilization, particularly for house-heating and other preferred fuel uses where the convenience of oil would allow it to compete with coal at a considerably lower cost; and, at the same time, stabilize the supply so as to make such expansion of utilization practical by providing large reserves of petroleum in above-ground storage.

As shown by a previous quotation, Doherty had been working on the idea of expanding the markets for petroleum as early as 1921. It was his idea that there was an enormous field for the expansion of the use of petroleum

products, particularly as fuel for house-heating and in selected industries where the advantage of oil over coal would outweigh the difference in price between the two fuels, and that the advantages of oil would still keep it in use although the price differential was considerably greater than it ever had been. Consequently oil as fuel could be removed from competition with coal on the price basis of a steam-raising fuel and could be applied to selected or preferred uses. This use, for house-heating in particular, would furnish a winter demand which would eliminate or lessen the seasonal fluctuation in the industry due to the summer demand for gasoline, and at the same time would make a profitable product out of fuel oil, and remove from gasoline and lubricants the burden of being the only sources of profit for the industry.

From a series of conferences with the manufacturers of domestic oil-burners held during 1922 and 1923, Doherty discovered that the use of oil for house-heating had been greatly retarded by the general fear that the supply of petroleum would not be sufficient for its continued use for this purpose, as well as by the frequent and wide fluctuations in the price of the product, which generally appeared, to the consumer, to be without rhyme or reason. Such progress as had been made had been entirely the result of the activities of the oil-burner manufacturers, without co-operation from the petroleum industry.[15]

During 1923, Doherty proposed to the American Petroleum Institute that $100,000 a year be appropriated by the industry through the Institute for advertising and educational work designed to increase the utilization of petroleum as fuel for selected purposes, particularly for house-heating. He pointed out:[16]

1. That more than 1,000,000 barrels of oil were being burned daily, much of which was being sold for purposes for which coal was equally available.

2. That the oil industry spent nothing collectively to expand the uses of oil nor to remove the fuel oil from direct competition with coal into fields where it would command a better price, although other industries of less magnitude expended sums ranging from hundreds of thousands to as much as $5,000,000 a year for such work.

3. That the experience of the artificial gas business had shown that consumers would willingly pay for artificial gas for house-heating a price equivalent to twenty to thirty cents a gallon of fuel oil, on account of its convenience and cleanliness as compared to coal.

4. That there were also other fields such as industries requiring high temperature furnaces, the railroads, ship propulsion, and farming, where oil would have a much greater value than coal and would be utilized at a much higher price.

Mr. Doherty also made the statement that the industry should be able to sell all the oil being produced at an increased revenue of $1,000,000,000 a year if the proper efforts at increased utilization were made, and called attention to the fact that the suggested appropriation of $100,000 a year was only one one-hundredth of one per cent of that amount.

15. Manuscript of L. C. Snider, etc.

16. Addresses before the National Petroleum Marketers Association, September 20, 1928. Also, American Petroleum Institute, December, 1923, reported in bulletin of the Institute, Vol. IV, No. 73, pp. 6-10.

The suggestion for the appropriation of $100,000 annually for advertising and for co-operation with the manufacturers of domestic oil-burners was not received favorably by the committee on utilization of petroleum products. The other members felt that the industry would not listen sympathetically to a request for a sum larger than a small part of the $100,000, and Doherty did not believe that any results of consequence could be obtained from the smaller sum.

It was also the concensus of opinion that a sufficient and stable supply of petroleum could not be assured for such uses and that the installation by consumers of expensive equipment which would be rendered useless later by failure of supply or by prohibitive prices for the oil products would react to the great damage of the oil industry.

Consequently nothing was done, and there has been little concerted effort, up to 1930, by the industry toward increased utilization of petroleum products.

It is interesting to note, however, that in the early part of 1928, some advertising was being done by individual companies to increase automobile touring and the consumption of gasoline without direct mention of their own products to the exclusion of others. Some of the leading papers at the meeting of the American Petroleum Institute in December 1927, and at the meeting of the petroleum division of the American Institute of Mining and Metallurgical Engineers in February 1928, stressed the necessity for co-operation in securing the increased utilization of petroleum products. The editorial in *The Oil and Gas Journal* for March 1, 1928, points out the advantages of group advertising, of the charm of travel and the noteworthy interest in increasing "consumption journeys" of gasoline as against advertising of competitive brands and an article in the issue for March 29 lists the co-operative organizations using group advertising and discusses the advantages of such advertising and publicity programs. While so far directed toward increasing sales of gasoline rather than the heavier products, the trend toward group effort in expanding consumption as advocated by Doherty in 1923 is unmistakable.

Mr. Doherty long had realized that it was necessary to stabilize the supply and prices of crude petroleum if the utilization was to be expanded along the lines and in the measure he thought possible. His first effort along this line was a consideration of the possibility of building enormous reservoirs for above-ground storage, to be filled during times of overproduction and drawn upon in times of shortage. He soon became convinced that above-ground storage of sufficient magnitude to act in any degree as an equalizer in smoothing out the fluctuations in supply and in reducing the wide variation in prices, was impractical and that this problem would have to be attacked from the production end of the industry.

As shown by previous quotations Doherty did not believe that the domestic supply of petroleum was sufficient to provide for the constantly growing demands of the United States under the methods of utilization practiced, al-

though anticipating a shortage for essential or preferred uses under ordinary conditions. His service on the petroleum division of the United States fuel administration during the world war had impressed him with the vital importance of petroleum as a munition of war and with the danger in which the United States would be placed in our domestic supply should become exhausted or greatly curtailed so that we should have to depend on imports or substitutes while other nations still had a plentiful supply.

The waste in development due to the frenzied haste made necessary by off-set drilling in new fields; the overdrilling, sometimes resulting in several times the necessary number of wells—due to the same cause; and the waste of energy in the escape of gas with which it is associated, which were inseparable accompaniments of development under the prevailing practice, made a particularly strong impression on Doherty on account of his experience as an engineer in other fields than the petroleum industry.

His study of the situation had convinced him that all of these evils were rooted in the laws under which the producing division of the petroleum industry operated, i. e., the recognition of property right in oil and gas only after they had been reduced to possession—the "right of capture"—and the fact that ownership or leasehold of the surface gave only the right to explore for oil and gas. He regarded any fundamental improvement in the situation impossible so long as the owner or lessor of each separate piece of property was compelled to protect his property from drainage by offset drilling with its attendant consequences of haste and waste.

He also regarded the report of the La Follette investigating committee as indicating a very real danger of governmental regulation of the details of the business of the industry, and his experience in the public utility field had made him particularly aware of the dangers of unfriendly or ill-advised regulatory legislation.

The plan for the operation of oil fields as geologic units, which Doherty proposed to the executive committee of the American Petroleum Institute during the summer of 1927, had the following objectives:

1. To conserve the oil resources of the United States and keep it as far as possible, on a parity with other nations whose supplies were, relatively or actually, less nearly exhausted; and at the same time

2. To stabilize the industry by permitting the discovery and outlining of pools without the necessity for their immediate development and depletion, thus establishing large underground reserves which would justify expanding of the utilization of petroleum products, particularly of fuel oils, so that gasoline would not have to carry the entire burden of profits for the industry; and

3. To remove the necessity for off-set drilling and thus do away with the frenzied development of new pools with the resultant over-drilling and other wastes—and coincidentally

4. To conserve natural gas both for its own fuel value and for its expulsive power on the oil. At the time of the proposal of the unit plan, the value of gas as an expulsive and

lifting agent for oil was recognized, but the conception of its importance in oil production was greatly magnified a short time later by the discovery of the effect of dissolved gas on the physical properties of oil, associated, so that much greater oil recovery could be had than when the gas is permitted to escape freely; and

5. By stabilization to correct the fluctuating character of the industry, thereby removing the principal source of criticism toward it and avoiding the danger of ill-advised or unfriendly legislative regulation.[17]

The proposal for unit operation was referred to a sub-committee of the American Petroleum Institute for consideration, and was the occasion for considerable debate among the members of this sub-committee during the remainder of the year. Nothing was made public as to the details of the plan, during the year, and at the fourth annual meeting of the American Petroleum Institute in December there was little or no public discussion of the plan although it was referred to by Doherty[18] in an address on the "Utilization of Petroleum Products" as follows:

We are cursed primarily by the fact that the rules of property ownership are different in the production end of the oil business than in any other business in the world and are likened only to the rules relating to wild animals and birds.

This makes it impossible for us to have vast bodies of oil resources located and large bodies of it blocked out that can be drawn upon as the market demands it. The location of an oil pool means under present conditions that it must be immediately forced upon the market whether the market can take it or not . . . .

. . . . . .We are continually vibrating back and forth between an overproduction of oil and the threat of a shortage of oil with no adequate resources on which to draw to stabilize either our supplies or our prices. Our customers are alarmed at times for fear they will not have a supply and are continually irritated and annoyed by wide fluctuations in price. The man on the street compares our business with every other branch of business and concludes that such fluctuations in price can only result from either mismanagement or manipulation. . . .

Until our laws can be changed to put us on an even footing with all other forms of property we must contend with this inability to control production except over wide ranges, but even operating under this handicap we can better things immensely. . . .

The program I have been recommending for sometime is this:

1. That we make such changes in the basic methods of producing crude oil that the raw product will be located in vast quantities and blocked out in large amounts so as to be readily accessible and under conditions whereby it will not have to be forced upon the market in excess of what the market can absorb.

2. That we stimulate every oil company to develop all possible demonstrated applications for the utilization of oil.

3. That we give support, encouragement and assistance to inventors and manufacturers of all oil burning apparatus.

4. That the industry as a whole shall contribute and co-operate to develop such uses for oil, as the individual companies for competitive reasons are not wararnted in doing.

The agitation concerning the condition of the industry which was so active during 1923 continued even more actively during 1924. The situation

17. Manuscript of L. C. Snider, etc.
18. Bulletin of the American Petroleum Institute, Vol. IV, No. 73.

of the industry was somewhat improved with a notable decline in domestic production from the peak reached in 1923. Oil continued to go into storage for the greater part of the year, however. The price for the average Mid-Continent crude rose from $1.00 to $2.00 the barrel in the first few months and then declined to $1.25 by the end of the year.

The discussion of Doherty's unit plan in the executive committee of the American Petroleum Institute was continued but the other members of the sub-committee, as well as the executive committee did not agree with the plan.

The first public presentation of the plan was made in an address before the annual convention of the National Petroleum Marketers Association at Cleveland in the early fall of 1924. In this address Doherty again stressed the importance of expanding the utilization of petroleum particularly for house-heating but gave more attention to a discussion of the unit plan which was proposed as follows:

An oil pool is something created by nature. The division of surface ownership even if created prior to the discovery of the pool can not change the nature of the pool and certainly divisions of surface ownership created after the discovery of the pool can not change the nature of the pool. No one owning or acquiring subdivisions of property should be allowed to operate his own property in a reckless and wasteful manner and to the detriment of the adjacent properties. The pool can not be properly conserved for the benefit of all or for the benefit of the public unless it is operated as a unit.

The legislatures of many states have already recognized the necessity for special legislation on matters of lesser importance than this, and where the iniquities of individual operation were not as shocking as in oil pools the courts have sustained this legislation. You will find a mass of special legislation on the common operation of properties.

You will be interested perhaps in studying the special legislation regarding irrigation and drainage districts where the owners of land are compelled by law to pool their interests and to operate as a district if the majority so elects. The plan I have advocated for the production of oil goes no further than to use the same character of legislation than has already been used for these irrigation and drainage districts and this special legislation has already secured the sanction of our courts.

I would propose:

1. That no one be allowed to drill for oil without first receiving a state permit to do so.

2. That nobody would be given a permit to drill for oil until an exploration district had been established.

3. That the exploration for oil should be restricted to that part of the exploration district one mile from the outer boundaries.

4. That the strip of one-half mile within the outer boundaries of the district should not be drilled for a period of one year after oil or gas had been found in commercial quantities or sooner but not until the exploration district had been enlarged or another district had been established adjacent to it and that the contractors in the two districts—if separate districts are formed—should not attempt to drill either half mile strip until they had agreed on a plan on which it should be drilled, and failing to agree upon a plan, then the state engineer could specify the plan suggested by either contractor or a plan of his own.

5. That royalties should be paid to the trustees of the district and they would settle with the individual land holders according to the calculated amount of oil or gas underlying each man's land.

In his discussion of his proposal Doherty mentioned the objection that had been raised concerning the distribution of royalties, namely, that it would not be possible to make equitable division of royalties, on the basis of the oil originally present under the land since this could not be determined accurately. His reply to this objection was that the division on this basis could be made more equitable than on the present basis of capture, whereby some landowners get as much as thirty times as much oil as they are entitled to; that the conservation of gas would greatly increase the recovery thus benefiting the royalty owners; and that if the attempt to divide the royalty on the basis of the oil originally present under the land led to delay or litigation there would be a natural tendency on the part of the royalty owners to agree in advance on some other basis of division such as a ratable division on the total amount of acreage, or on the amount of productive acreage, in the exploration district.

Doherty closed his remarks on the unit plan as follows:

So long as we operate under the present system we will be unable to prevent either an oversupply of oil or a shortage. We can not create ground resources in a true sense or as it is true with all other mineral products. So long as these conditions prevail our business will be subjected to violent fluctuations. So long as these violent fluctuations prevail the public will believe our industry is either grossly mismanaged or grossly manipulated. So long as these conditions prevail nobody will be willing to adopt and use our heavy products for fuel and pay for them at their real value so long as the present uncertainty of supply exists.

President A. L. Beaty of the Texas Oil Company and chairman of the sub-committee of the American Petroleum Institute expressed[19] his reasons for being opposed to the plan in his address at the annual meeting in 1924. His objections may be summarized as follows:

1. The impairment of contracts and taking of property without due process of law if the plan applied to established fields.
2. The difficulty of exercising rights held on non-productive leaseholds if the plan should apply to existing leases.
3. The difficulty of forming districts in most areas considered at all favorable if the plan should not apply to existing leases but cover all unleased territory, in view of the large amount of such territory under lease.
4. The difficulty of initiating activities under the new plan.
5. The difficulty of securing trustees of sufficient knowledge and capabilities to handle the affairs of the district and the dangers of local politics and petty graft.
6. The difficulty of apportioning royalties.
7. The revolution in the entire industry necessary to fit it to the new system.

So much had been said about conservation and stabilization by 1924 that President Coolidge appointed the federal oil conservation board consisting of

19. Bulletin of the American Petroleum Institute, Vol. V, 1924, pp. 17-19.

the secretary of war, the secretary of the navy, the secretary of the interior, and the secretary of commerce. In his letter creating the board, after outlining the general conditions existing in the industry, he said that he was constituting the board to study the government's responsibilities and to enlist the full co-operation of representatives of the industry in the investigation. The work of the federal oil conservation board will be discussed in a later chapter.

The announcement of the creation of this board was received with mixed feelings by the leaders in the industry, most of whom having experienced a series of investigation in recent years did not relish another one. They had a fear that the board was the beginning of a series of investigations leading to governmental regulation and control. W. H. Gray, president of the National Association of Independent Oil Producers expressed this sentiment in his address before that body when he said:[20]

> The question in the mind of the producer is: "What is this commission going to do? Will it confine its activities to the conservation of the tremendous resources of the government in the way of public land for national defense or is it the purpose of this commission to make a survey of the entire industry with a view of recommending legislation fastening upon the industry some measure of control and regulation? Is it going to suggest that the hand of the government be laid upon private property for future industrial welfare?" From a recent interview given out by the secretary of the interior in Chicago, one would gather the impression that the federal government contemplated taking control of the private properties of those engaged in the oil industry; that some form of regulation of privately owned property was to be undertaken by the federal government.
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> If it is true that the purpose of this commission is to recommend legislation seeking to control the activities of the independent producer upon his own property, then it is indeed, a bold step and one which will need much explanation on the part of the government as to why the petroleum industry should be singled out for legislation and control. . .

At the fifth annual meeting of the American Petroleum Institute at Fort Worth, December, 1924, the directors of the Institute would not permit Henry L. Doherty to reply to the criticisms of his unit plan contained in the presidential address of T. A. O'Donnell and in the address of A. L. Beaty previously quoted. It was arranged that Doherty and Beaty should discuss the plan further before the directors at a meeting to be held in Colorado Springs in February. The place of this meeting was changed to Atlantic City and was held January 12, 1925. The Doherty plan was discussed in secret session of the directors and was disapproved, the directors agreeing with a motion by E. W. Marland to appoint a special committee to draft a resolution of disapproval.[21] The resolution adopted reads:

> It is the sense of this meeting that the plan submitted by Mr. Doherty for the consideration of this board, designed by him to solve some of the problems of the industry, will in judgment of this board, not solve those problems, among other reasons, because: First, we do not agree with his premises and we believe that the plan would not result in the production of more oil and gas than is produced by present methods. Second, the plan would

20. *The Oil and Gas Journal,* January 15, 1925, p. 22.
21. *National Petroleum News,* January 14, 1925, pp. 17 and 29-31.

eliminate the small producer and concentrate the production of the future in the hands of a few large operating companies. Third, the plan contemplated the destruction of existing property rights. Fourth, the plan presents practical operating difficulties so numerous that it is impossible for us to see how under it we could continue to furnish an adequate supply.

At the Atlantic City meeting of the directors, the appointment of the federal oil conservation board was discussed, as was also the first questionnaire, which had been received by the directors. On motion of A. C. Bedford, chairman of the board of the Standard Oil Company of New Jersey, a resolution offering full co-operation to the federal oil conservation board was adopted.

At this meeting a committee of eleven was authorized consisting of the president and general secretary of the Institute and nine other members with the power to appoint sub-committees to collect the facts, to study the problems pertinent thereto and to report its conclusions and recommendations to the board and the committee was requested to seek the views and co-operation of all branches of the industry with regard to the problem of conservation.

The report[22] was published in August, 1925. The summary of the conclusions of the committee is as follows:

1. There is no imminent danger of the exhaustion of the petroleum reserves of the United States.

2. It is reasonable to assume that a sufficient supply of oil will be available for national defense and for essential uses in the United States beyond the time when science will limit the demand by developing more efficient use of, or substitutes for, oil, or will displace its use as a source of power by harnessing a natural energy.

3. Current supply and demand cannot stay in balance, since the amount of both supply and demand are constantly changing. Generally, current supply will exceed or be less than demand, creating surplus or shortage; either condition will be reflected in price, but price will in time correct either condition.

4. Petroleum recoverable by present methods of flowing and pumping from existing wells and acreage thus proven consist of five billion three hundred million (5,300,000,000) barrels of crude oil.

5. It is estimated that after pumping and flowing there will remain in the area now producing and proved twenty six billion (26,000,000,000) barrels of crude oil, a considerable portion of which can be recovered by improved and known processes such as flooding with water, the introduction of air and gas pressure and mining, when price justifies.

6. Improved methods of deep drilling below oil sands now producing will disclose in many areas deposits not hitherto available, which will be tantamount to the discovery of new fields. Improved methods of producing have been perfected which will make possible recovery of oil from these lower levels. The limit of deep drilling has not been reached.

7. The major oil reserves of the United States lie in some one billion, one hundred million (1,100,000,000) acres of land underlain by sedimentary rocks, and not fully explored, in which geology indicates oil is possible. With extended search new supplies will be found therein.

8. The nation has an additional reserve in the vast deposits of oil shale, coal and lignites from all of which liquid fuel and lubricants may be extracted if and when the

22. *American Petroleum—Supply and Demand*, McGraw-Hill Book Company, New York, 1925.

cost of recovery is justified by the price of these products. These deposits are so huge that they promise, under conservative estimates, an almost unlimited supply.

9. While this report is confined to the petroleum supply and demand within the continental United States the importance of imports cannot be ignored. Countries to the south are known to have large petroleum resources, for the out-put of which the United States is a natural market and the supply therefrom must inevitably have its influence on the consumption of American reserves.

10. The availability of future petroleum supplies from the vast area of land mentioned above depends upon adequate incentives to the exploration which in the past has given the nation a sufficient supply of petroleum, in peace and in war, throughout the history of the oil industry, from its inception in 1859.

There must be:

a. Security in the ownership of oil lands and of the right to lease.

b. Conditions of exploration and development by owners or lessees permitting exercise of initiative, liberty of action, the play of competition and the free operation of the law of supply and demand.

c. Prices that will provide a return to producers, refiners, and distributers commensurate to the risks involved and the capital invested.

11. The supply of petroleum will be made to go much further through more efficient utilization. Automotive experts state that the mileage of the motor car per gallon of gasoline may be doubled through structural mechanical changes, when price justifies such changes. Improved mechanics will also result in smaller consumption of lubricants.

12. Through improved methods, principally the process known as "cracking," the refining branch of the industry has already increased the yield of gasoline, now the major product of petroleum. Through further improvements and extensions the supply of gasoline will be augmented still further by the "cracking" of fuel oil. In consequence the supply of fuel oil will be correspondingly diminished, thus eventually removing fuel oil from competition with coal.

13. Waste in the production, transportation, refining and distribution of petroleum and its products is negligible.

This report of the committee of eleven was received with mixed opinions. The chief criticisms of the report are as follows: the motive that prompted the report was a personal one, the supply was overestimated, substitutes are no assurance against famine, there is little waste, and lastly the extent of the billion acre reserve has been questioned.

It is strange that this report should pay so little attention to waste when A. L. Beaty[23] at the annual meeting of the American Petroleum Institute in 1922 said, "We are now in a period of waste and extravagance," and E. W. Marland said,[24] "We must admit the almost criminal waste."

Mr. Doherty's unit plan of operation had been criticised because it did not include sufficient detail. At the meeting of the American Institute of Mining and Mechanical Engineers in February, 1925, he expanded some of its features. They related to governmental issue of drilling permits, drainage dis-

23. Bulletin of the American Petroleum Institute, Vol. III, No. 62, p. 62.
24. *Mid-Continent Year Book*, 1923, pp. 40-43.

tances, and the formation of oil exploration districts. The recommendations are:[25]

My recommendation at this time is this, viz:—

1. That no land shall be drilled for oil until opened up by a government permit.

2. That all land within drainage distance of existing production shall be opened for drilling. For example, all land within 2,000 feet of a producing well shall be opened for drilling and as fast as a new well is brought in, a new radius shall be established opening up all land within 2,000 feet of each new well. This will enable existing pools to be driven to their boundaries and without opening up other and distinct pools.

3. That permission to drill land not subject to drainage shall be granted only when an oil exploration district has been formed. All land embraced in the district, which is one-half mile or more from the outer boundaries, shall be opened for drilling without restriction. No drilling shall be done on the outer strip of one-half mile, except with the consent of all land owners within one-half mile of the proposed well, and wells located in this strip can only be drilled for exploration purposes, but must not be allowed to produce except as specified hereafter. The district can drill at will and produce without restriction other than in this half-mile strip, but cannot drill in this strip without consent of the owners of the adjacent property and cannot produce oil or gas from this strip until a twelve month period has elapsed, and then only, if no adjacent district has been formed. If an adjacent district has been formed, then if the two districts can agree as to how this strip (of one mile wide and made up by a half-mile strip in each district) shall be drilled, then drilling can commence at once, but if they cannot agree, then each must submit plans to the proper officer of the government, and this officer shall select one of the two plans, or submit a plan of his own, which shall be final, and drilling can then commence, but the plan adopted by the government official can be modified in case of subsequent agreement between the two districts.

The plan had received criticisms from the legal angle. In reply to these Mr. Doherty said that the existing laws and practices already in force in the various localities could be utilized. The same laws that apply to drainage and irrigation projects could be used in his unit plan. The questions that are affected by the local laws are the fixing of boundaries; the bringing of election to decide whether or not to drill; the right of voting and method of holding elections; the selection of directors and trustees; disposal of faulty titles; operation by land owners or contractors; assessments of costs and awards of benefits and settlement of disputes concerning such costs and awards; and settlement of conflicts with lands controlled by state or federal government. Mr. Doherty also recommended that costs of exploration should be assessed against the subsurface rights or mineral rights rather than against the surface rights as in drainage and irrigation districts.

Mr. Doherty advocated federal legislation respecting conservation and gave the following reasons for the stand he took:

1. That conservation measures should be adopted at once and delay will result, if the states are relied upon to do so.

2. That such legislation should be uniform throughout the country and apply to all states, even if not now producing oil.

25. Manuscript of L. C. Snider, etc.

3. That the federal government should retain power so it can adopt further conservation measures if necessary.

4. That oil is our most important munition of war and the only one in danger of imminent depletion to the point of crippling us in event of war.

5. That oil can be conserved, our national stocks greatly preserved, and ground reserves of oil can be created by merely changing the laws under which we operate, and this is not true of any other natural resource.

6. That the powers granted to the federal government under article 1, section 8 "to provide for the common defense" are ample to warrant such legislation and:

7. That the obligation assumed by the federal government under article 4, section 4, makes it the duty of the federal government to the separate states, to take whatever steps are necessary to conserve our oil, so as to insure the carrying out of the pledge by the federal government to protect each state from invasion. Under this obligation assumed by our government, I think any non-producing state would have a right to demand that our federal government should immediately take such steps as may be necessary to conserve the nation's oil reserves. . . . . Such a supply as I propose would be such a formidable war resource, that in my opinion no national power or combination of powers would be willing to declare war against us, but if they did, it would be our most powerful weapon of defense.

If this plan were adopted, Mr. Doherty maintained that double as much oil could be recovered as is obtained now and sixty-six and two-thirds per cent of the gas could be conserved; that the pools would produce steadily and economically and be maintained in the same condition that now characterizes flush production. In the event of war production could be increased immediately to take care of the increased needs of the government and industry.

Among the engineers who discussed this plan were Julius Fohs, Max Ball, and Everett De Golyer.[26] Mr. Fohs' view was that too many basic laws would have to be changed to put the plan into operation. Other plans could be employed more easily that would be as effective. He did not think small operators should be permitted to force production. He thought the government should restrict production on their reserves; that by education future operators would put production on a more scientific basis; that the determination of reserves should be done through co-operative effort with the government; that in this determination all factors including improved methods, price, etc., should be included. Mr. Ball thought that one of the difficulties in the way would be the granting of a permit. This power would be in the hands of a government official who would decide whether or not a pool should be opened. If the official refused to grant a permit because prices were too low so that oil companies could not make money he would be subject to severe criticism from the public who is not interested in the financial success of oil companies. According to Mr. De Golyer the plan was favorable for large companies who might obtain control of pools but it would be hard for the small operators to get a share of the development. He thought that gas might be conserved under the plan but doubted whether more oil would be recovered. The effect

26. *The Oil and Gas Journal,* February 26, 1925, p. 26.

of the change to the plan would have a more unstabilizing influence than the forces now in operation. The plan would be all right after it was underway but the attempt to change it would unsettle the industry more than it is now.

The status of the report of the committee of eleven gave the federal oil board some concern. Although it was referred to as the "Institute report" it in reality did not bear the endorsement of the Institute. The board had some fifteen letters from men in the industry putting themselves on record as not subscribing to it. This book was treated as the joint report of eleven men and given the same status by the board as the individual answers to the questionnaires sent out by it.[27]

The activities of the federal oil conservation board, the report of the committee of eleven, and Mr. Doherty's unit plan created a great deal of discussion and feeling within the industry. *The Oil Weekly* of October 21, 1925, stated editorially that the report of the committee of eleven was a report by experts and expressed the assurance that there is an adequate supply of petroleum for years to come. It also charged that President Coolidge received his inspiration for the creation of the federal oil conservation board, or at least borrowed a part of the inspiration, from Mr. Doherty. The editorial recognized Mr. Doherty's tenacious pugnacity and said that he didn't know when he was beaten and that he still challenged the Institute. It remarked that it was difficult to understand how Mr. Doherty could divide his time with public utilities and still know more about the oil business than all the other big minds. The report of the committee of eleven was approved by the Texas section of the Mid-Continent Oil and Gas Association in October, 1925, and by a majority of the directors of the American Petroleum Institute in December, 1925.

In 1926 the discussions before the trade associations and scientific organizations continued. Articles appeared in the trade journals on conservation and conservation methods. A paper was presented to the petroleum division of the American Institute of Mining and Metallurgical Engineers[28] by L. L. Dunn and James O. Lewis on the advantages of unit operation in new pools. The conclusions of these engineers were very favorable in regard to the advantages of unit operation and are as follows:

1. A pool of oil is a natural unit no matter how large, and operations cannot be conducted independently without increased costs and reducing both recovery and profits.

2. Important savings in development and production costs can be made by reason of operating on a larger scale without the necessity of undue haste and with the opportunity for carefully working out a development program in advance.

3. Important savings can be made in the number of wells drilled, which can also be more effectively located to get the maximum production and to minimize the waste of gas and oil.

27. Manuscript of L. C. Snider, etc.
28. *Petroleum Development and Technology for 1926,* American Institute of Mining and Metallurgical Engineers, pp. 177-194.

4. Unit development would also permit the use of improved production methods most of which rely upon the control of pressure in the sand, including back pressure, stop-cocking, gas or air lifts, holding in of gassy wells.

5. Under unit development artificial pressure can be applied earlier, and possibly wells can be flowed throughout the life of the field. Production can be sustained over a longer period and can be controlled more in accordance with the price of oil, which would minimize the disastrous fluctuations in oil prices.

6. Profits would be increased and, under conditions as at Cromwell, should be several times those realizable under competitive operation.

7. Unit development would be in the public interests, as it will increase and prolong supply, will create more capital, and reduce the final cost of products to the consumer.

The first report of the federal oil conservation board appeared in September, 1926. The report dealt briefly with the development, production and use of petroleum, known fields, future reserves, proven fields, possible new fields, foreign sources, substitutes, action to be taken in reinforcement of supply, control of flush flow, the government's own problem, and a statement that the inquiry would continue.

Also, in May, 1926, the board held public hearings in which Charles Evans Hughes, counsel for the American Petroleum Institute, appeared before them in the interests of the industry. After listening to the address by Judge Hughes, Mr. Doherty requested that he be given permission to make a statement in writing later. This permission was granted by the board. Judge Hughes' address and Mr. Doherty's reply are contained in the report of the public hearing before the board on May 27, 1926. The theories advocated by these men will be referred to in a later chapter.

Recommendations for Regulation

The year 1927 was very eventful in the movement toward stabilization. Two events that gained wide attention were the appointment of the committee of nine by the federal oil conservation board and the report of the federal trade commission on *Prices, Profits and Competition in the Petroleum Industry.*

The committee of nine was appointed by the federal oil conservation board to consider a legislative program for the conservation of the gas and petroleum resources of the United States. Three representatives from the petroleum industry, all past-presidents of the American Petroleum Institute, were recommended by President Clark of the Institute and appointed. They were Thomas A. O'Donnell, J. Edgar Pew and W. S. Farish. The three representatives of the American Bar Association recommended by a committee appointed for that purpose were Henry M. Bates, James A. Veasey, and Warren Olney, jr. The other three members of the committee representing the government were Abram F. Myers, Walter F. Brown, and E. C. Finney.

The report of the committee was published in February, 1929, and their recommendations were:[29]

29. Federal oil conservation board, report three, February 25, 1929, p. 17.

1. Federal legislation which shall (a) unequivocally declare that agreements for the co-operative development and operation of single pools are not in violation of the federal anti-trust laws, and (b) permit, under suitable safeguards, the making, in times of over-production, of agreements between oil producers for the curtailment of production. The form of such legislation which we would suggest is:

2. Similar legislation by the various oil-producing states.

3. Immediate further study into the matter of the waste of natural gas in order that legislation may be formulated which will forbid such waste as fully as may be done without working injustice and unreasonable hardship.

4. Legislation by congress granting the secretary of the interior authority to join and to permit lessees from the government to join in agreements for the co-operative development and operation of single pools.

5. The passage by congress of the legislation heretofore recommended to it by the secretary of the interior, removing the existing mandate upon him to offer for lease annually, regardless of conditions, 100,000 acres of Osage Indian lands.

The federal trade commission in submitting its report to congress stated that it had observed a growing sentiment for regulating production of petroleum so as to conserve the supply and protect the financial interests of land owners and operating companies. The commission announced that it was not prepared to recommend particular methods to be used since this problem was being considered by the federal oil conservation board.

On May 12, 1927, the federal oil conservation board issued a press release declaring that the overproduction of oil in the United States "has recurred this year in a form so malignant as to seem to be without precedent in all past history" and that Walter C. Teagle, president of the Standard Oil Company of New Jersey, and W. S. Farish, former president of the American Petroleum Institute, had filed with the board a plea for federal assistance to meet the situation.

In their joint statement Mr. Teagle and Mr. Farish suggested that wildcatting practices be amended in order that the amount of flush oil be reduced to prevent periods of overproduction. To eliminate the practice, they suggested that interested producers, instead of purchasing full interests in definite sub-divisions of the wildcatter's block of acreage, purchase undivided fractional interests in such blocks.

Many of the leaders in the industry by 1928 were convinced of the need for some kind of legislation relating to the conservation of petroleum. In keeping with a recommendation in the first report of the board, Secretary Work, chairman of the board, sent letters to the governors of twenty oil producing states. Secretary Work, in his letter to the governors explained, that the oil board was convinced that the necessity for conservation was acknowledged both by the oil industry executives, government scientists, and economists. He said that the board in its survey of national petroleum conditions and the committee of nine representing the government, the oil industry, and the American Bar Association, had reached certain definite conclusions that

conditions today in the oil world were conducive to needless waste and economic distress.

On April 3, 1929, a committee from the American Petroleum Institute conferred with the federal oil conservation board in regard to its proposed program for holding production down to the average of its 1928 level in this country and in Mexico and in northern South America. Attorney General William D. Mitchell informed the committee by letter that the Institute program would be in violation of the federal anti-trust laws and by coming to the board with this plan they were virtually asking immunity from prosecution under these laws which immunity the board had no power to bestow.

The general committee of the American Petroleum Institute on world production and consumption of petroleum and its products at its meeting in Houston, Texas, March 20, 1929 outlined an economic program whereby production would be held to the level of 1928. At the end of 1929, however, there was in storage in the United States 500,000,000 barrels of crude oil with estimates of shut-in production running as high as 1,200,000 barrels daily in the United States and 800,000 in other countries. According to R. C. Holmes,[30] president of the Texas Oil Company, the cut in the price of crude oil in January, 1930, would not have happened if the production had been held to the limit set at this meeting.

Mr. Holmes stated that the failure to accomplish all that was hoped for was due to legal difficulties, particularly in the states of California and Texas. California's crude production in 1929 exceeded the 1928 production by over 60,000,000 barrels. Texas exceeded the 1928 production in 1929, by 41,000,000 barrels. The increase of the entire United States amounted to 104,000,000 barrels.[31]

Any attempt to check the situation through regulation of refinery runs or gasoline stocks Mr. Holmes thought would lead into technical and legal difficulties not able to be overcome. The remedy lies, he thinks, in the reduction of production by application of the California gas conservation law in that state and for the legislature of Texas to amend its laws so that producers in that state can cut their production without violating the anti-trust laws.

The board continued its efforts in line with the idea suggested in its first report to bring about legislation controlling production. Since the production of petroleum is a matter of state control, the oil conservation board worked out a plan for a "compact" of principal oil producing states, under federal approval. The details of this plan were set forth in a letter by Secretary Wilbur, chairman of the board, to R. C. Holmes, president of the Texas Company and

30. R. C. Holmes, "The Crude Oil Situation," *Texaco Magazine*, March, 1930.
31. *Idem.*

chairman of the special Institute committee on supply and demand for oil. Secretary Wilbur's letter to Mr. Holmes in part was as follows:[32]

> The problem (regulation of drilling) appears to the board therefore, due to the legal inhibitions, to be one in the real solution of which action must be secured from the different states. The board recognizes that individual state action without co-ordination would not cover the question, but with a view to bringing about such a program and its co-ordination, the board believes it would be worthwhile to renew discussion with the state authorities of the three of four principal oil producing states, particularly to learn if it is not possible for them to enter upon an inter-state compact under the provisions of the constitution authorizing such compacts to which the federal government through congressional action would be a party.
>
> The character of such a compact would need much consideration, but it could well comprise creating a joint board for the purpose of constructive conservation and thus secure the nation from the very real peril that will lie in the reckless extension of our oil resources.

Dr. George Otis Smith, director of the United States geological survey and chairman of the federal oil conservation board's technical advisory committee, was sent to lay the oil board's plan before the governors of Oklahoma, Texas, California, Wyoming, Colorado, and other oil producing states to secure their views concerning it.

A conference of the governors was called for June 10, 1929, at Colorado Springs, Colorado, by President Hoover to discuss and formulate a practical program for the conservation of petroleum resources. Mark L. Requa, personal friend of President Hoover and formerly general director of the oil division of the United States fuel administration in 1918 and 1919, was appointed by President Hoover as chairman for this conference. Delegations from Oklahoma, Texas, California, Kansas, Arkansas, Louisiana, Pennsylvania, Montana, Colorado, Wyoming, New Mexico, and Utah were present, including four governors.

The conference accomplished nothing because the delegates came uninstructed and they had no authority to commit their governors, legislatures, and people to a policy of forming a state compact. Even had the delegates power to form a compact then and there no doubt the conference would have ended in failure. The idea of state's rights is too strong to permit any kind of compact where these rights would be weakened. The conference began badly, another reason for its lack of accomplishment. In his opening address Chairman Requa intimated that if the industry did not get together on its own initiative that the government would have to use coercive methods. This idea caused so much discussion at the sessions that it caused Senator Bronson M. Cutting to make verbal attacks on Requa in the United States senate. The idea of coercion threw the debate into such a frame of mind that at the beginning there was little chance for arriving at any kind of agreement or plan. Mr.

32. *National Petroleum News*, April 17, 1929, p. 27.

Requa made many explanations of his statement and said emphatically that he was in favor of coercion only as the last resort.

Even the Oklahoma delegation could not agree on some points. For example, E. W. Marland said there is no actual waste of oil; that the committee of the American Petroleum Institute of which he was chairman had finished its study and had found no economic waste. Pat Malloy, attorney from Tulsa, said, "there is no such thing as economic waste in the production of oil in Oklahoma."[33] J. A. Veasey, attorney for the Carter Oil Company, said:

> In the first place, those of us who are really familiar with conditions will not dispute that there is an economic waste in the sands. The oil is driven into uses to which it should not be put under existing conditions. I think we will also agree that there is another form of waste, partaking partly of the nature of an economic and partly of a physical waste, in the sense that the gas energy is not used to the highest efficiency in the production of oil. Those, I take it, are two fundamentals in this situation which no one truly conversant with the situation will seriously dispute. Therefore, the question of conservation is of extreme importance.[34]

This conference did serve to accentuate the cleavage between two groups within the industry. On the one side are the big integrated companies, both "Standard" and "Independent," who are more in favor of some kind of governmental regulation and legislation controlling the production of petroleum. This group is more prominent in the American Petroleum Institute and is closely co-operating with the federal oil conservation board in its efforts to bring about some form of conservation and stabilization. The second group does not represent as large investment in the industry but from the point of numbers is considerably larger. This group includes the independent producers, royalty owners, independent refiners, intrastate pipeline operators, supply men, oil field workers, owners of permits to operate on government lands, and lease and royalty brokers.

As a matter of principle both groups are interested in conservation. They are all in the business to make money. In applying the proposed plans of conservation there is a conflict of interest. The first group wants to curtail production to a minimum. By doing so, supply will be curtailed and prices rise. If production is cut to a minimum and some kind of control placed over it the second group feels that it will be cut off from its source of livelihood. They have to produce oil to make money and money is made in flush pools, its members say. Curtailment of production cuts off royalties, sales by supply men, the source of supply to the independent refiner, and the prices of leases and royalties are reduced. The states in which are the largest producing areas derive a large part of their revenues from a gross production tax. If production is cut down in these states their source of revenue is reduced.

An association of independent producers was formed to further their in-

33. *Tulsa Daily World*, June 16, 1929.
34. *Idem.*

terests particularly the tariff. The name of the organization is Independent Producers Association. The initials of this organization are I. P. A. which is the reverse order of those of the American Petroleum Institute, A. P. I. The headquarters of the Independent Producers Association are at Ardmore, Oklahoma.

Three reports were published late in the spring of 1930 that should have considerable influence on the development of stabilization within the industry.

The first in order is the report of the committee on petroleum economics which was appointed by the federal oil conservation board in March, 1930. The report of this committee was made March 25 and made public April 14, 1930. The purpose of this committee was to determine what is the anticipated consumption of refined products, what production of crude is necessary to meet efficiently that demand and to determine if this supply can be allocated to the major producing districts separately. The committee, composed of J. Elmer Thomas, chairman, Joseph E. Pogue, secretary, Ray M. Collins, H. W. Lowrie, jr., and H. P. Grimm, reported that their forecast of the demand during 1930 is 476,700,000 barrels of gasoline, 456,000,000 barrels of fuel oil, and 130,000,000 of other products. They estimated the supply of domestic crude oil required to meet this demand efficiently is 942,800,000 barrels, allowing for a moderate reduction in stocks of refined products. The committee suggested a reasonable allocation of production requirements as between the larger producing states, adjusted so as to relate to the last nine months of 1930 in barrels *per diem* as follows: California, 610,000 barrels; Oklahoma, 655,000 barrels; Texas, 750,000 barrels; all others, 480,000 barrels; and from storage, 78,000 barrels. It is too early to make an appraisal of the influence of this report.

The federal oil conservation board through its chairman, Secretary Wilbur, on May 28, transmitted its fourth report to the president of the United States. The subjects covered by the board in its report are: Economics of the petroleum situation in which it discusses supply and demand of petroleum and shows that there is a condition of overproduction existing in the industry; revision of estimates of oil supply and arrives at the conclusion that estimates of supply cannot be accurately made and that in the interests of national defense and industrial prosperity this generation should not be permitted to waste this irreplaceable natural product and thus seriously handicap future generations of Americans; economics of natural gas distribution in which the consumption and distribution of natural gas is discussed and the economies of its transportation; need of full utilization of gas as a productive agent in the fields and as a fuel and the need for the stoppage of present waste of this valuable product; the last section of the report is devoted to the progress of unit operation in which it states that this plan seems by common consent to have commended itself more than any other and that justice to all owners and bene-

fit to the public can both result in the observance of natural and economic law in recognizing the oil pool as the natural unit.

The Mid-Continent Oil and Gas Association under the direction of the general secretary, Harry H. Smith, published in May a *Handbook on Unitization of Oil Pools*. Its nature is best described in the following paragraph taken from the introductory chapter:

> It is the purpose of this elementary handbook to explain and describe the principles and practices of unitization, its practical workings and benefits in an effort to contribute something to the progress of that extremely important movement. For the most part the book simply consists of compilations of the thoughts, writings and experiences of others than the writer and it is the intention to give proper credit in every instance. In addition to the valuable suggestions of the unitization committee of the general Mid-Continent Oil and Gas Association and of land department heads, lawyers, practical and scientific men of that organization, special mention should be made of the co-operation of the members of the American Institute of Mining and Metallurgical Engineers whose papers were so freely drawn upon for illustrative and substantiating data in the preparation of the book.

CHAPTER EIGHT

PRORATION

FORCES that have led up to a crystallization of opinion in the industry with reference to plans for stabilization, were outlined in the preceding chapter. Two plans have been worked out for regulating production and have been put in effect in certain places with varying results. These two plans are proration and unit operation.

Proration has carried two meanings when used by the industry. Oklahoma has a law known as the common purchasers' act, later adopted by other states, whereby all purchasing companies are required to buy all oil and gas offered to them for sale. The purpose of this law was to prevent discrimination. Frequently production exceeded the ability of the purchasing companies to take all the oil. Since these companies could not take all the oil and gas offered to them it was necessary to prorate the runs from the various leases. The proration was done with the consent of the corporation commission when it was shown that the purchasing company could not handle economically all the oil and gas offered it. The proration was made upon the percentage basis.

A common example of this type of proration was a communication sent by the Sinclair Oil Company[1] to its producers in the states of Oklahoma, Texas and Kansas. This communication announced that beginning with seven a. m. July 1, 1924, and continuing thereafter until further notice the company would purchase under the division orders then existing fifty per cent of the crude oil production from the existing wells upon the leases from which it was then purchasing oil; the other fifty per cent of the crude oil production from such wells it would accept and store in its common crude oil stock, but without regard to gravity. The storage charge announced was three cents a barrel the calendar month. There was an additional charge for gathering and transportation according to the published tariff provisions of the Sinclair Pipe Line Company. The company obtained the option of purchasing all the oil in storage at the current posted price at the time the option was executed. There were other provisions in this communication relative to the execution of the proration order.

Although proration orders had a tendency to check drilling in certain areas it did not solve the problem of overproduction because operators could

1. *Okmulgee* (Oklahoma) *Democrat*, June 30, 1924.

still run their oil into storage. The stored oil had the same effect on prices whether it was owned by the operator or by the purchasing company.

The other meaning given to proration is the one used now most commonly by the industry. Proration, as it is understood today, is the limitation placed upon production by the operators upon a *pro rata* basis. By agreement, each operator is allotted a part of the available outlet which is intended to be that fraction of the total which the oil ultimately to be produced from the lease of the operator in question bears to the total volume of oil ultimately to be produced from the whole field. The purpose of proration is to postpone production and not change the proportions to come from one property as compared with another.

This form of co-operation is usually worked out with the state authorities in which is the area affected. In Oklahoma proration plans are worked out in co-operation with the corporation commission. The railroad commission acts for the state in Texas. The states in which the overproduction of oil is a serious problem have laws regulating the waste of petroleum and natural gas resources. Under the authority granted by this law the state commissions co-operate with the companies to prevent physical and economic waste. In recent years the commissions have not acted until appealed to by the representatives of the industry affected.

One of the earliest proration orders of the state of Oklahoma, acting through the corporation commission, was in 1921 when Frank M. Breen and others made application to the commission for the enforcement of the conservation laws prohibiting waste.[2] It was represented that crude oil was being produced in the Hewitt field and its extensions in excess of transportation or marketing facilities, or reasonable market demand, and under such conditions as to constitute waste as defined by the conservation law. A large number of oil producers operating in the field appeared before the commission in support of the petition.

The commission held a hearing in Ardmore, June 11, 1921, at which time it took testimony regarding conditions in that field. After hearing the testimony the commission found that there was economic waste and it was the opinion of this body that production should be curtailed until such a time as there was a reasonable market for the oil.

The commission ordered that no new wells should be drilled after the order became effective, which was immediately, except where it was necessary to protect the operator's title; where an operator was engaged actually in drilling a well he could complete it; off-set wells could be drilled if oil was

2. Twenty-first Annual Report of the Corporation Commission of the State of Oklahoma, 1928, p. 137.

being taken from the adjacent wells, provided the off-set well be drilled within three hundred and thirty feet of the boundary line.

A committee of five operators was appointed to act in an advisory capacity to the oil and gas division of the corporation commission. Any operator who could show cause could be relieved of any burden placed upon him by the commission's order on recommendation by this committee. Operators who were bound under contract to drill could obtain permission from the corporation commission upon the recommendation of this committee. Pipelines and purchasers were prohibited from buying and taking any oil from wells drilled in violation of this order. The operators were required to furnish a permit by the corporation commission before the pipelines and purchasing companies could take oil from new wells. The shooting of any well in this area affected by the commission's order was prohibited without a permit from the commission. It was also provided if any operator felt aggrieved with any of these rules and regulations of the commission or of the committee appointed by it might, within five days upon complaint to the corporation commission, be heard and such order or ruling as might be necessary could be made therefrom.

This order accomplished little. While the Hewitt field was an important field at that time a curtailment of production was insufficient to affect the market. Regardless of the power that might be placed in the hands of the corporation commission to curtail production there must be complete co-operation on the part of the industry. Co-operative effort on the part of the industry to bring about stabilization had gained little headway at this time. Curtailment efforts in the Hewitt field died a natural death from the want of co-operation.

The next attempt at proration was in 1926. That year the Seminole field which was an area of small holdings was producing oil in immense quantities. Attempts at voluntary control were made in the fall of 1926 but they came to naught. The spring of 1927 saw the situation growing worse. A meeting of executives of the larger companies operating in this field was called for May 11, in New York. W. C. Teagle of the Standard Oil Company of New Jersey presided at this conference. Later there were meetings held by the operating heads of the companies nearer the fields. At these meetings there were great differences of opinion. Some proposed to restrict production twenty-five per cent. Some said forty per cent. Others wanted all flush production wells reduced to two hundred barrels a day. All were of the opinion that something should be done to curtail production. The dif-

ference in opinion lay in the method by which the plan should be carried out.[3]

The results of this meeting were:

1. Agreement to attempt another curtailment of drilling at Seminole, the first trial to last two weeks.

2. Re-appointment of Ray H. Collins, Tulsa, who served as umpire during the November shut-down, to serve as arbiter during the two weeks trial agreement during which time he should make a survey of the drilling requirements and report at a meeting May 25 to be held in New York.

3. Appointment of a committee of five to confer with the federal oil conservation board in the attempt to develop a plan to be national in scope to halt over-production.

Seminole Curtailment Plan

The results of the Tulsa meeting were to place Mr. Collins in control of production activities. He ordered that no wells other than off-sets be drilled in for fifteen days. No wells should be started without consulting him. Mr. Collins approached his problem scientifically by requesting complete information and data on all drilling wells in the greater Seminole area. He also asked the pipeline companies not to make new connections to wells without consulting him. He submitted a report on the results of these activities at a meeting in New York on May 25. A resolution was passed endorsing his plan and to continue his service as umpire. At this meeting Mr. Teagle made a report for the committee of five who were to confer with the federal oil conservation board. He reported that the board stated it had no legal powers and could not approve or disapprove any definite plan.

There were so many exceptions to the rule that daily production increased from 350,000 barrels in May to 527,000 barrels in July. The situation was complicated by the opening of an extension to the area by drilling in new wells in the Little River pool south of Seminole. At a meeting of the operators it was agreed to start only twelve designated wells which were necessary off-sets and by lease requirements. The discovery well was to flow unrestricted until the first of these wells was completed when all the wells were to be pinched in to one hundred barrels daily production. Not all the operators signed the agreement.

Mr. Collins appealed to the corporation commission in July for an order curtailing production. A hearing was given July 21, 1927. An order was made to stop shooting all wells in the Seminole field and the drilling in of any additional wells until August 5, 1927, on which date there would be another hearing. On August 9 Mr. Collins filed a contract and agreement between the operators and producers of oil in this field in which they agreed to a curtailment plan whereby production would be held to a total of 450,000 barrels a day, the production from the different leases to be prorated accord-

3. *National Petroleum News,* May 18, 1927, p. 17.

ing to the potential production of each lease. The commission directed Mr. Collins to act as umpire under the direction and advice of a committee of five practical Seminole operators. Attorney General J. Berry King, representing the state of Oklahoma, filed a motion with the commission to adopt the terms and provisions of this curtailment plan and contract and incorporate them in the order.

The commission in its order said:

1. That the testimony showed a waste of oil in the Seminole field as defined by the statutes of Oklahoma.

2. That if the terms and provisions of the curtailment plan and contract entered into between the operators and producers of oil in this field were carried into effect it would prevent further waste of oil in the field.

3. That it was necessary under the terms and provisions of this plan and contract to have an umpire acting under the direction and with the advice of a committee to carry into effect the plan and agreement; the umpire was to be appointed by the commission and to have the power to enforce the terms and provisions of this order.

4. This order was to remain in effect until further order of the commission.

Therefore, it was ordered by the commission that the curtailment plan and contract be made a part of the order. Mr. Collins was appointed umpire. Pipeline companies operating in that field were ordered to take only so much oil from each of the leases and wells as might be allowed to produce from said lease and wells by the terms and conditions of the order.

The points set forth in the curtailment plan are:

1. The plan shall continue in force sixty days.

2. Mr. Collins shall act as umpire with a committee of five appointed at a meeting of the Seminole operators.

3. The umpire is to assemble all the necessary data relative to production in this field and to wire each operator what his share of the production shall be.

4. The production shall be limited to 450,000 barrels a day from the Searight, Seminole, Bowlegs, and Earlsboro pools in the greater Seminole area. Each lease may produce the same proportion of the allowable production of four hundred and fifty thousand barrels a day which the potential production of such lease bears to the total potential production of all said pools, as such potential production determined by the umpire.

5. For the purpose of determining the potential production of leases covered hereby, and of administering this plan in relation thereto, all leases in the Searight and Seminole pools shall be classified as "old properties," and all leases in the Bowlegs and Earlsboro pools shall be classified as "new properties." Initially, the potential daily production of each lease, whether falling in one or the other of the two classes indicated above, shall be determined in the following manner: The umpire, from scouting reports available to him, shall ascertain the average daily production of each lease for the ten day period ending July 29, 1927, and the figure so found shall represent the potential production of said lease for the first period that the plan is put into operation. New wells coming in after July 29, 1927, whether on old or new properties, shall be dealt with as follows: After the new well shall have been producing for three days, the third day's production thereof shall be regarded as the potential production of the particular well for the time being, and the amount thereof shall be added to the potential production of the particular lease previously ascertained, and the total shall constitute the potential production of the said lease for the purpose of this plan. With reference to all old properties covered hereby, the potential

production figures attributable thereto shall be applied for intervals of ten days. At the end of each ten day interval, the potential production of all of such old properties shall be readjusted upon the basis of the production decline curve applicable to properties in the Searight and Seminole pools. In relation to new properties, the potential production, ascertained by the umpire, shall apply from day to day only, such potential production to be readjusted each day upon the basis of the production decline curve found to exist either in the Earlsboro or Bowlegs pool as the case may be, depending upon the location of the particular lease in one of said pools or the other. Appreciating the difficulty of readjusting the potential production of leases under the plan, any operator feeling himself aggrieved by any ruling of the umpire in this regard may appeal to the committee of five, which committee shall have authority either to affirm or modify the ruling of the umpire according to the equities of the particular case.

6. Each operator is to inform the umpire who is his representative in the field authorized to receive the orders from the umpire.

7. Sections 35 and 36, township 8 north, range 6 east, and sections 1 and 2, township 7 north, range 6 east shall be designated as "Zone No. One" for the purpose of this plan. During the period the plan remains in force, no drilling restrictions shall be imposed on leases located in said zone. But, as long as the plan remains in force, no wells located in said zone shall be shot. Until a second well shall have been drilled in and put to producing in said zone, the Indian Territory Illuminating Oil Company may produce its discovery well therein to full capacity in order to obtain customary drainage advantage resulting from the early commencement and completion of said well. But when said second well in said zone shall be put to producing, said second well and the discovery well of the Illuminating company shall each be pinched in to a production of one hundred barrels a day, which requirement shall continue as long as the plan remains in force.

Sections 8 and 9 relate to the creation of zones in certain areas described.

10. This relates to the creation of zones in the event certain wildcat wells then drilling should come in as producers.

11. No well shall be permitted to be shot in the Searight, Seminole, Bowlegs, and Earlsboro districts without consent of the umpire.

12. If any operator were to feel that he was being discriminated against he could appeal to the committee of five who could give him any relief it saw fit.[4]

The Seminole pool reached its peak in July with a daily production of 527,000 barrels and then started on a decline. There was some question as to the practical effects of this curtailment program. Some thought that with the natural decline most leases could produce all the oil they were capable of producing and still stay within the amounts assigned to them by the proration orders. Some officials of the companies operating in this field were very outspoken in regard to the effects of the plan.

The development of important fields in west Texas in 1926 and 1927 added to the problem of overproduction. The situation was different in this section, however, because of the lack of pipeline facilities, the division of land into larger units, and the presence of a large sulphur content in the oil which was very corrosive when stored in steel tanks.

Since 1927 the corporation commission of Oklahoma has issued several

4. Order No. 3944, Cause No. 8101, Twenty-first Annual Report of the Corporation Commission of the State of Oklahoma, 1928, p. 474.

orders curtailing production. Each time the areas have been extended. In recent months the commission has been making it a practice to extend the old order rather than issue a new one and has made journal entries to that effect.

The operators of Oklahoma met in Tulsa, March 18, 1930, and agreed to ask the commission to order a further curtailment of production until July 1, 1930. The proration percentages to be continued ranging from thirty per cent to eighty-seven and one-half per cent in the flush fields.

The producers met again in Tulsa July 15 and agreed to reduce the production in Oklahoma to 550,000 barrels a day subject to the approval of the Oklahoma corporation commission. This action was taken on the recommendation of the statewide proration committee of the Mid-Continent Oil and Gas Association of which C. C. Herndon, vice-president of the Skelly Oil Company was chairman.

The producers were prompted to take this step of further curtailment because on June 30 at a meeting of the refiners in New York City the refiners decided on a reduction of crude runs to stills in order to bring about greater stability within the industry. The purchasing companies were also restricting their purchases in the principal fields of the state which fact was also another reason for curtailment. According to *The Oil and Gas Journal* the estimated daily potential production in the state of Oklahoma for July is 1,400,532 barrels and for August 1,351,861 barrels. The allowed production according to their agreement ranges from eighteen and three-fourth per cent in some fields to fifty per cent in others. It is intended that this agreement should remain in force until September 1, 1930.

The effects of proration in Oklahoma may be estimated from the report of the umpire, Ray M. Collins, for the last week in October, 1929. Table XI shows the potential, allowed, and actual production from the flush pools in Oklahoma excepting the Oklahoma City pool. The estimated daily average production for the Oklahoma City pool by *The Oil and Gas Journal* for the week ending March 15, 1930, was 85,095 barrels. This is estimated to be twelve and one-half per cent of its potential production.

The Oklahoma conservation law has never been seriously tested by the courts. A temporary restraining order was obtained in the district court at Wewoka, Seminole county, by a group of royalty owners. The case was carried to the supreme court, which dissolved the injunction on the ground that the corporation commission had judicial powers over that of the district court.

An oil company operating in the Little River district secured a temporary restraining order from Federal Judge Edgar S. Vaught of the western district of Oklahoma. At the hearing Judge Vaught dissolved the order on

TABLE XI*

Potential, Allowed, and Actual Gauges of Production of Flush Pools in Oklahoma, Excepting Oklahoma City, Last Week of October, 1929.

Pools	*Potential*	*Allowed*	*Actual*
Allen Dome	23,720	18,976	19,000
Allen (Wilcox Sand)	5,700	4,562	4,542
Sasakwa	11,785	9,429	9,947
Marshall	19,078	15,265	16,102
Asher	6,616	5,291	5,472
East Earlsboro	50,625	25,575	25,709
Earlsboro proper	48,411	38,729	40,000
Bowlegs	31,877	25,502	26,000
Carr City	11,141	8,913	9,000
Little River	56,082	44,866	46,000
East Little River	26,904	21,524	22,606
Maud	11,851	9,481	9,800
Mission	23,541	18,833	19,000
Seminole City	32,514	26,011	26,500
East Seminole	8,144	6,515	6,700
Searight	12,599	10,079	10,500
St. Louis	66,944	53,555	56,000
Pearson	1,113	890	1,000
TOTAL	448,645	343,996	353,332

**Daily Oklahoman,* November 3, 1929.

the ground that the state had the right to curtail drilling activity to eliminate waste through its police power. (At the time of going to press the proration order of the corporation commission affecting the Oklahoma City field was being attacked by the Julian Oil Company. Oral arguments had been presented by both sides. The supreme court had not yet rendered its opinion.)

Proration in Texas

The Yates pool in west Texas, Pecos county, offered one of the most unusual problems, in that production was found at the unusally shallow depth of one hundred feet. Individual well production was enormous. Some wells gauged as high as seventy thousand barrels a day on the basis of one hour flows. Although the field was divided into large tracts there was a sufficient division of ownership to have brought a flood of oil upon the market had the facilities been available. The low price of oil retarded the development of pipeline facilities adequate to take the oil.

Proration in the Yates field was made possible through the co-operation of the Texas railroad commission and the operators. The program was carried out by the commission. The field was divided into one-hundred-acre producing units, each of which was entitled to its outlet, regardless of the number of wells in excess of one which might be drilled upon it. Three-fourths of the total outlet available was apportioned among the several units in the same proportion that the potential daily production of the individual unit bears to the total potential production of the whole field. In arriving at the potential production of the individual unit and of the whole area the

field was gauged on an individual one-well to-the-unit basis. If any operator had drilled more than one well on his unit of one hundred acres, the average production of the number of wells was taken to arrive at the one-well-the-unit basis. The remaining one-fourth of the available outlet was divided equally among the several producing units. Drilling has always been held down in this field and it appears that the field will never be drilled closer than one well to the forty acres.[5]

The Hendricks field in Winkler county was developed rapidly during the latter part of 1927 and the early part of 1928. Discussion of voluntary co-operation to restrict drilling and production came to nothing and in May the railroad commission of the state limited production and prorated it among the operators. A combination of the production and acreage bases, which had been tried in the Pecos field, was used in prorating the production. The more important provisions of the commission's order are as follows:

1. The production of the field is limited to 150,000 barrels a day.
2. The section surveys in the field are divided into units of forty acres each.

The amount of oil to be taken from each forty-acre unit is determined as follows:

> Each unit shall be entitled to have removed and marketed or stored therefrom a quantity daily equal to the quotient obtained by dividing one-half of the daily market outlet for the period involved by the number of forty-acre units in the field and producing at the commencement of such period without reference to the number of wells located on such units, and in addition thereto shall be entitled to have removed and marketed or stored therefrom daily, its *pro rata* of one-half the daily market outlet based on the ratio of the daily potential production from such unit to the daily potential production from the field. No oil in excess of such amount shall be produced from any forty-acre units.

3. Smaller holdings than forty acres are given a production based on the fraction they represent of forty-acres.
4. The daily potential production as applied means the number of barrels which can be produced in twenty-four hours, and is to be determined on the first and fifteenth of each month and these determinations govern the prorating for each succeeding half-month period.
5. Oil placed in storage for each half-month period is limited to the amount produced in that period by above regulations, and notice must be given the railroad commission of intention to store.
6. Use of air or gas lift, and operating in such way as to waste gas unnecessarily is forbidden.
7. Shooting of wells is forbidden except with approval of railroad commission.
8. It provided for selection of a general committee of operators and an advisory committee of seven from the general committee, who shall select, with approval the railroad commission, an umpire, who is to be agent and enforcement officer of the commission.
9. It provided that an advisory committee may review or revoke any ruling of the umpire, or appeal to the commission, with the orders of the advisory committee being in effect until action by the commission.
10. It limited the number of wells to one well for ten acres, distance between wells

5. "What Price Competition?" *The Lamp,* June, 1929, p. 9.

to 660 feet and distance of wells from boundaries to 330 feet except in special cases where this stipulation may be varied by consent of the commission.[6]

According to a dispatch to the *National Petroleum News* under a Houston date line of November 7, 1929,[7] the wells in the Winkler area in west Texas were unable to make their prorating allotments. The total daily potential production for the period October 16-31, 1929, was 239,477 barrels The daily allowed production for this period was 142,017 barrels. The daily actual production for the month of September, 1929, was 118,393 barrels. The potentials for this area no longer reflect exploitable production above the actual. The potential figures for this area had been maintained for several months. Proration was continued in this field until May 5, 1930, under the approval of the Texas railway commission which enforces the state's conservation statutes.

Proration plans have been continued in the other fields in Texas down to date. The details have been altered from time to time depending on the condition of production in the respective fields and the character of the market. The operators met in Fort Worth, January 31, 1930, when a general executive committee was appointed by Edward T. Moore, president of the Texas division of the Mid-Continent Oil and Gas Association, for the purpose of studying the various producing areas of the state to determine if it was necessary to curtail their daily production to a still lower plane.

The Independent Petroleum Association, the Mid-Continent Oil and Gas Association and representatives of the crude oil purchasing companies met in Dallas, Texas, the same day that Oklahoma producers met in Tulsa, July 15, and adopted a report of a special committee, excepting some minor details, which was to be submitted to the Texas railroad commission. The purpose of this report was to present a picture of conditions prevailing in the industry with a view of working out a plan in co-operation with the commission for prorating production. It was estimated there was at the time a surplus daily production of 750,000 barrels in Texas.

Other Curtailment Operations

There are two pools in Kansas[8] where the operators have entered into voluntary agreement to curtail production. The operators in the Valley Center pool, Sedgwick county, agreed to a fifty per cent reduction in production in this area in 1929. The second voluntary curtailment plan was by the operators in the Voshell pool in McPherson county in October, 1929. It was agreed by all the operators in the pool not to start any more wells until January 1,

6. Manuscript of L. C. Snider, etc.
7. *National Petroleum News,* November 13, 1929, p. 40.
8. W. A. Spinney, "Oil Conservation in Kansas Extended," *The Oil and Gas Journal,* October 17, 1929, p. 44.

1930 and to shut in the production of the Derby Oil Company's well to fifty barrels a day, effective immediately. The Derby Oil Company was given discovery rights. New wells started in January were not permitted to be completed before April 1, 1930. This delayed bringing new production on the market and prolonged the shut-down period.

The curtailment problem in New Mexico has a different aspect from that in the other states, for here the opponent to the movement was the state.[9] The operators in the Hobbs district, Lea county, met with representatives of the New Mexico state land board and others on October 22, 1929, to discuss plans for curtailing production in this new pool. The purpose of the meeting was to prevent an excessive drilling campaign in face of a condition of overproduction. There were only five wells in this area with an approximate daily production of 2,000 barrels. This pool has no outlet for its oil since the nearest pipelines and railroad are fifty miles away. The leading companies wanted to restrict production. The state owns forty per cent of the land and was opposed to the plan. Dr. Austin D. Crile, land commissioner of New Mexico, was reported as saying that while he desired "a regular and orderly" program for development and production by lessees in that area, there was no assurance that crude oil would not be worth much less in the future and that the common schools in the state were in need of the income from royalties. He said that he felt it to be his duty as trustee for those institutions not to hazard the results of shuting down production at that time. He maintained that the argument of overproduction was without merit due to the relatively small output of the state. No decision was reached at this meeting.

Conditions in New Mexico had changed so much by July, 1930, that the land commissioner changed his opinion and thought there was a very urgent need for a conservation of the petroleum resources in that state. The potential production had increased to about 148,000 barrels. There were twenty-six completed wells and about fifty-five located, rigged up or drilling. Outlets had been made to the pool through the pipelines of the Shell Pipe Line Company, the Humble Pipe Line Company and the Atlantic Pipe Line Company.

According to *The Oil and Gas Journal*[10] it is planned to operate the pool upon the basis of forty-acre units and prorate the oil twenty-five per cent upon acreage covered by these units and seventy-five per cent upon the average daily potential production of each unit. This is similar to the Yates plan except that at Yates the units are one hundred acres each.

With twenty-two units now productive in the Hobbs pool this would

9. *The Oil and Gas Journal,* October 31, 1929, p. 62.
10. L. G. E. Bignell, "Hobbs Pool Will Be Sanely Developed," *The Oil and Gas Journal,* July 17, 1930, p. 32.

give each well a run of about 415 barrels daily based upon acreage and about 1,175 barrels daily based upon the seventy-five per cent run to make up the total of 35,000 barrels daily that this field will run to pipelines. These figures are subject to change every fifteen days as new wells are added and new units come within the producing area of the field.

Proration has been attempted for some time in California along the lines carried out in Oklahoma. These attempts have met with only limited success due to the conditions peculiar to that state. Although most of the production is controlled by large integrated companies enough of it is in control of small operators who are not in sympathy with proration agreements, at least not with those proposed.

Until the bringing in of high gravity crudes in more recent months the bulk of California oil has been low grade oil of low price. The California operators have for a long time been accustomed to receive a small price for their oil. Consequently, being hardened to the situation they do not become so alarmed as do the Mid-Continent operators when there is a threat of falling prices. Being accustomed, therefore, to a condition of low prices they are more difficult to persuade to enter into agreements unanimously limiting production.

The state legislature of California in January, 1929, passed a bill known as the California conservation law. This law encourages mutual agreements between operators to prevent waste and makes all agreements binding and enforceable by action in specific performance.

Section 8c of this law provides:

Whenever the state oil and gas supervisor finds that it is in the interests of the protection of oil or gas from unreasonable waste it is lawful for the lessor, lessee, operator or other persons, firms and corporations owning or controlling royalties or other interests in the separate properties of the same producing or prospective oil or gas field to enter into agreement with the approval of the state oil and gas supervisor for the purpose of bringing about the co-operative development and operation of all or a part or parts of such field for the purpose of bringing about the development of operation of all or part of any field as a unit or for the purpose of fixing the time, location and manner of drilling and operating of wells for the production of oil or gas, or providing for the return of natural gas into the subsurface of the earth for the purpose of storage of the repressuring of an oil or gas field.

The enforcement of this law is in charge of the state oil and gas supervisor. It is one of the duties of the supervisor to see that there is no unreasonable waste in the production of oil and gas. R. D. Bush, the state oil and gas supervisor, in a letter to the writer states that unreasonable waste is not defined except for the declaration that the blowing of gas to the air shall be *prima facie* evidence of unreasonable waste, which puts the burden of proof of unreasonableness upon the producer.

Approximately 275,000,000 feet of natural gas is being blown into the

air at Santa Fe Springs every twenty-four hours.[11] An attempt to enforce the law in this area resulted in a complaint for an injunction against operators in the Santa Fe Springs field before Judge William Hazlett of the superior court in Los Angeles. After announcing his decision on the validity of the gas law, Judge Hazlett ordered the defendants to show cause why a temporary restraining order should not be issued as requested by the state and the hearing to decide this point was immediately started. There are other cases to be heard yet affecting the operators in other fields. The real test of the law will not come until the operators carry the case to the supreme court of the state. One interesting feature in the opinion of Judge Hazlett which will be brought up in a subsequent chapter is the theory of the interest of the public in natural resources as it affects private interests.

According to the *National Petroleum News* ninety per cent of the flush production of California is covered by proration agreements. The California industry entered its second three months period of curtailment of production February 1, 1930. A few of the independent operators at Santa Fe Springs have failed to enter into the agreements to prorate their output but since their total daily yield does not exceed 35,000 barrels the umpire, Paul Grimm, stated that the situation could be held under control.[12]

Voluntary production has met with the best success in Oklahoma. Oklahoma has been left to carry the heaviest burden through her proration plans during the last three years in the efforts to stabilize the crude oil production in the United States. The efforts have materially benefited the industry generally because if Oklahoma had recklessly thrown her production on the market without any effort at curtailment economic waste would have been appalling in its magnitude. Because of the failure to co-operate completely in other states it has resulted in a loss to Oklahoma operators and a reduction of revenues into the general funds of the state treasury through loss in gross production taxes.

11. *The Oil and Gas Journal,* March 20, 1930, p. 60.
12. *National Petroleum News,* February 5, 1930, p. 52.

CHAPTER NINE

UNIT OPERATION

WHEN H. L. Doherty proposed his plan of unit operation it was considered rank heresy by many of the leaders of the industry. Although the leaders are not all in sympathy with the plan in its entirety, today, they are in sympathy with the idea. Unit operation of oil pools is one of the goals by which they hope to achieve some degree of stabilization of the industry. Thus far proration has been more effective than unit operation because it involves greater areas and greater potential production. However, proration is only a temporary measure. Unit operation has a more scientific basis.

The industry has coined a word, not found in the dictionaries, to cover the meaning of unit operation. The verb is "unitize" and the noun is "unitization." Unitization is defined as

> the process by which divided interests in an oil and/or gas pool containing a number of tracts of land are converted into undivided interests in the entire area; where the owner of the oil or gas rights in an individual tract or tracts of land surrenders his exclusive ownership thereof in return for an assignment to him of an undivided interest in the oil and gas rights of the pool as a whole; the purpose being to develop and operate the area as one property or unit through the instrumentality of a common agent, trustee or committee and thus avoid unnecessary competitive drilling, waste of gas and duplication of effort and secure greater recovery of oil at less cost.[1]

The use of this word has three objectionable features. In the first place it is not needed. Unit operation may be used to convey the same meaning. It does not add beauty to the language nor is it pleasing to the ear. There is no need to add words to the vocabulary when there is a sufficient number to serve the same purpose. Unit operation is better because it expresses the idea more clearly. In the next place it is thought by some to have been invented so that the idea might be adopted without seeming to credit thereby Henry L. Doherty who had employed poor tactics in pushing forward the idea. Lastly, the suffix "ization" is likely to convey a different meaning to the public at large than what the industry intends for it to convey. It suggests the idea of monopoly and mergers rather than economy and efficiency. Unfortunately there is too much skepticism at large concerning the motives of the petroleum industry. Those charged with promoting its welfare can ill afford at this time to take any chances in intensifying something that should remain dormant. "Unitization" might arouse suspicion. Unit operation connotes a clearer meaning.

Unit operation is not monopoly operation. It is no more monopoly oper-

1. Report of the committee on voluntary unitization, Annual Report of the Mid-Continent Oil and Gas Association, 1929, p. 5.

ation than is the case where there is one operator controlling a large area. There should be no fear of monopolistic control through unit operation because it would include land owners and operators in a single pool which is a comparatively small unit of production. If the land owners and operators controlled one or more units in a given area it would provide only a small percentage of the total production.

W. C. Teagle, president of the Standard Oil Company of New Jersey, and W. S. Farish, president of the Humble Oil and Refining Company, in their letter written in 1927 to Secretary Hubert Work, chairman of the federal oil conservation board, outlined a simple method of unit operation when they said:

> The procedure that we have to suggest is that instead of the interested producers purchasing full interests in definite subdivisions of the wildcatter's block of acreage they purchase undivided fractional interests in such block or acreage. Suppose, for example, ten operators, including the wildcatter, thus come to own the entire block and the test well in common. Suppose the enterprise be managed through a committee or board representing operators and royalty owners and each participant reserves the right to claim his ten per cent of the oil from every well that may be drilled on the property. Would not this course end the mad scramble whereby each operator now feels obliged to drill as many wells as possible and produce as much oil as possible before his competitors beat him to it? Would not the producers in this simple fashion eliminate this greatest obstacle to the intelligent development of production?[2]

Unit Operation Plans

Judge Amos L. Beaty, who so vigorously opposed Henry L. Doherty's first unit plan, particularly the part advocating involuntary co-operation, has proposed a plan for voluntary unit operation.[3] Judge Beaty's plan is really a unification plan—a plan whereby the interests in the pool are consolidated into a business unit for the purpose of operation. He does not think the corporate form of organization for such an enterprise advisable because in the early life of the pool there can be no very satisfactory determination of values. The owner of each lease has a good opinion of his property and the task of bringing about an agreement on values would be difficult. It would not promote harmony if a lease were turned in at low value which later on proved very valuable. Corporations cannot take property in payment for stock and leave the value open for future determination. Neither can they very well revise and adjust from time to time the value of property received and the amount of stock issued in return.

The same result can be accomplished, according to Judge Beaty, through an unincorporated trust. This trust would follow in most respects the practice of corporations. Under this plan the final valuation of the properties is deferred until the time arrives for the final distribution of the proceeds. In the

2. "The Meaning of Unit Operation," *The Lamp,* June, 1927, p. 7.
3. Amos L. Beaty, "Model Unit Plan Proposed," *The Oil and Gas Journal,* February 23, 1928, p. 29.

meantime there are tentative valuations for purpose of vote or management and *interim* distributions.

His plan may be summarized as follows:

Three or five trustees to be selected who sign a trust agreement embodying the terms of this plan. Properties in the pool are transferred to the trustees, under the terms and conditions of the trust agreement and the transferers receive from the trustees duly signed certificates stating that they have made such transfers and have become shareholders in the trust. All operations and business in connection with the properties included in the trust are carried on by the trustees, subject to the direction and control of the shareholders.

Shareholders meet at fixed times and places. Shareholders reach decisions by major value vote, except as otherwise provided in the plan.

The trust agreement does not become effective until the shareholders select three or five appraisers, whose duty it is to fix by unanimous or majority action the values of properties from time to time and also the voting strength of shareholders, based upon such values, and in like manner to change and readjust such voting strength as values change or properties are divided or transferred. The decisions of the appraisers must be binding and conclusive, and any shareholder may require a ruling by the appraisers whenever a question of values or voting strength arises.

The trustees keep all leases in force except as to lands barren of oil and gas.

Shareholders at their meeting may levy assessments for development purposes on the basis of values at the time of such levy. If the conditions warrant it by net earnings and cash on hand they may pay *interim* dividends prior to the termination of the trust. These payments are to be on the basis of the value to the trust estate, as seen at the time of such *interim* distribution, of the property and money contributed by the respective shareholders. Care must be taken to avoid payments which subsequent events might prove to be excessive.

When the trust is terminated the net assets are distributed so that each shareholder receives, counting *interim* and final dividends, his fair and equitable proportion of such assets, based upon the relative value to the trust estate. If shareholders fail to agree the appraisers fix the final proportions and amounts.

Unless otherwise dissolved, the trust agreement remains in force as long as the properties produce oil or gas in paying quantities. It may be dissolved at any time by three-fourths vote of the shareholders.

The interest of any shareholder may be assigned in whole or in part.

Trustees and appraisers may be removed by the major value vote of the shareholders. Vacancies must be filled to keep the number complete.

Compensation of trustees and appraisers are fixed by the shareholders.

Shareholders are given the preference right at equal prices to purchase oil or gas from the trust property in proportion to the value at the time to the trust estate of the properties and money contributed by them respectively.

Another method of carrying out unit operation is through the community lease, where the royalty owners join in a common lease to one company, the royalties to be dvided *pro rata* according to the percentage each royalty bears to the whole. Community leasing has not been carried on extensively because it is very difficult to get all the owners of oil and gas rights in a given area to enter into the agreement. If one or two stay out, the plan is ruined. Community leases have been successful in places where the circumstances surround-

ing it are unusual. For example, in the Oklahoma City field where the drilling has been approaching the corporate limits of the city there are many town lots laid out in proposed subdivisions. These lots, as a rule are too small to accomodate a rig and all that goes with it to drill a well. About an acre is necessary for the derrick, boiler house, slush pit, tanks, and other equipment. Oil companies operating in this field have taken community leases in order to combine these properties for more efficient operation. It is to the interest of the small property owner to enter into these agreements, for, if he did not, he would receive no benefit at all because his property is too small to accommodate a drilling outfit.

Community leases on a small area in a larger field are only in part unit operation. These leases check town-lot drilling and its attendant evils but unless they cover the whole pool the total benefits of unit operation are not obtained. Successful community leases have been carried out in Belvedere Gardens near Los Angeles and in the Long Beach field. Attempts at community leasing in Kansas and Michigan failed because of the failure to get complete co-operation from all the royalty owners.[4]

The federal government has been instrumental in some instances in bringing about unit operation on government land. The Salt Creek field in Wyoming is a particular example of co-operative effort in which an important factor has been federal supervision of operation on government leases. The preliminary report of the federal oil conservation board[5] gives an outline of the plan:

At the present time, the Salt creek field furnishes illustration of conservative development in a program for winning the oil from the lower sands that promises best returns to both the industry and the public. The productive area of the Lakota sand, less than four square miles, includes about twenty separate leases on federal and state lands, held by three companies but all operated by one company. Twenty-five wells have already been drilled through this sand, with large initial flows, but the only production of oil from Lakota sand has been that incidental to the drilling in or the subsequent short test of each well. Thirteen other wells have been drilled to the top of this sand, and the number of wells planned will be only sufficient to equalize the royalties to both owners and to private royalty owners, and it is expected that not more than two wells will be drilled to each forty acres. When the area is thus drilled up, and the market warrants drawing on this new supply of oil, back pressure will be maintained in the effort to obtain the maximum yield, a short test proving the material advantage of this method of conserving the gas. The government engineer supervising the federal leases estimates this shut-in capacity at Salt creek, based on actual tests, as slightly over 70,000 barrels, a potential initial daily production in excess of the present production from the upper sands.

President Hoover on July 9, 1930, signed the bill amending sections 17 and 27 of the general leasing act of 1920. This act promotes the cause of unit operation by permitting participation in unit agreements by both the

4. Manuscript of L. C. Snider, etc.

5. Report of the federal oil conservation board to the president of the United States, Part 1, September, 1926, p. 19.

government and authorized lessees of government lands. The department of the interior on the same day issued a press release pointing out that the government by this legislative enactment had subscribed to the principle of unit operation of single oil fields and thereby set an example for productive areas privately owned.

The release included a copy of a letter written by Secretary Wilbur to William Reinhardt, chairman of the North Dome committee of the Kettleman Hills field, explaining the new law. Secretary Wilbur said:

> It is with satisfaction that I can announce to your committee the signing by the president of the bill amending the general leasing act. This constitutes fulfillment of the undertaking set forth in the North Dome agreement of July 1925, a year ago, "that the secretary of the interior will propose the necessary legislation enabling the government's participation in the proposed co-operative plan." I trust your committee may now bring to a conclusion its constructive drafting of the plan of unit development so essential to the interest of both private and public owners of this gas and oil field.
>
> This official recognition by the legislative and executive branches of our government of the economic principle of unit operation has already been heralded in the press as marking "the high point in the progress of public understanding of the problems of the oil industry." And the response of both houses of congress to the request for this legislation was most gratifying.
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> In its report on the measure, the house committee on the public lands pointed out that the amendments "affect the workings of the leasing law only as to lessees in a single pool coming voluntarily under a co-operative plan duly approved by the secretary of the interior as in the public interest. The requirements of existing leases are changed only when desired by such lessees; the new legislation is permissive, providing a desirable flexibility in these requirements, but in no sense are any changes mandatory upon the government lessees."
>
> Speaking in support of the proposed legislation, which he sponsored in the senate, Senator Walsh of Montana explained that "the bill contemplates that parties having interests in a particular oil field may unite all of their interests and operate them as a unit, co-operatively, instead of each one operating his own individual property," And again "it should be explained that no one will be obliged to come in; there will be no coercion; the bill merely authorizes agreements among the operators and gives to the secretary of the interior the power to enter into such agreements on the part of the United States." The senate report, presented by Senator Walsh, was similarly explicit on this point: "No change would be made in any government leases, past or future, from the terms of the general leasing law, except as lessees in a single pool may wish to come under a co-operative plan, duly approved by the secretary of the interior as in the public interest."
>
> The senate committee's report referred specifically to the emergency existing at Kettleman Hills and stated that "a co-operative plan for meeting this waste problem more effectively is now being formulated by a representative committee of operators, but the lessees of the government land can not enter into such a plan without amendment of the general leasing law. Without participation by those government lessees occupying thirty per cent of the area of this very rich field, no co-operative plan can be operative."

The largest owners of leases and production are the Mountain Producers Corporation and the Salt Creek Producers Association. The Midwest Refining Company operates these properties under an agreement that does not expire until 1932, the Midwest bearing all costs of drilling and producing the oil

and paying for it at a price based upon the market price of gasoline in Casper.[6] A unit plan of operation for the Elk Basin field, Wyoming-Montana, was adopted by the Midwest Refining Company, the Continental Oil Company and the Ohio Oil Company in the early part of 1927. Leases in the Rainbow Bend pool in Kansas were jointly owned by three companies and were developed and operated in an orderly manner due to lack of competition. However, the interests of the different royalty owners had to be protected by line drilling.[7]

At the meeting of the American Institute of Metallurgical Engineers in Tulsa, October, 1929, a committee was appointed to make a study of unit operation and report at the meeting of the Institute when it met in New York in February, 1930. Earl Oliver of Ponca City was appointed general chairman. Joseph Jensen of Los Angeles was appointed chairman of a group to report on unit operation in California; Fred E. Wood of Casper, on the Rocky Mountain region; A. W. Ambrose and C. E. Beecher, of Bartlesville, on Kansas and Oklahoma; Frederic H. Lahee, of Dallas, on Texas, Arkansas, Louisiana and New Mexico; and Harry H. Hill and E. L. Estabrook, of New York City, on the Appalachian region and foreign fields.

The committee reported at the February meeting of the A. I. M. E. and their reports are summarized in *The Oil and Gas Journal*.[8] These were really progress reports and the committee did not offer any conclusions as a result of their study. No recommendations were offered but it was the opinion of the committee that unit operation is a logical and desirable trend in the oil industry and that there is sufficient public interest in the problem to justify continued analyses and support of the petroleum division of the A. I. M. E.

The report of the committee did show that there was a definite trend in the industry toward unit operation. There are many embryonic units already in existence. However, the results are not sufficient because the developments in most places have not gone far enough to form any definite conclusions. The committee also stated that the movement had not progressed to the point where any single method of unit operation has been evolved that is accepted by its authors as the one correct method to bring this about. Each attempt is an independent experiment and has been rewarded with varying degrees of success.

Approximately one hundred and eighty-five projects in the United States and foreign countries were studied by the committee. There were, out of this number, approximately fifteen singly operated pools in the United States and thirty-seven in foreign countries. There were in California, operated under some degree, fifteen pools, Oklahoma and Kansas fifty-seven, Texas and Louis-

6. *The Oil and Gas Journal*, November 10, 1927, p. 98.
7. Manuscript of L. C. Snider, etc.
8. "Report of the A. I. M. E. Unitization Study," *The Oil and Gas Journal*, March 20, 1930, p. 166.

iana approximately thirty, Rocky mountain region twenty-seven, and foreign countries four. A part of the pools that the committee included in the one hundred and eighty-five are co-operative pools and some would come under the classification given in the preceding chapter as proration. The amount of oil produced from unit operated areas in the United States in proportion to the total production was negligible. This committee estimated that fifty-five per cent of the foreign production was produced under unit operations. Most of the subsurface rights in foreign countries are owned by the government. The areas where oil is found in foreign countries are usually owned in large bodies, even where the subsurface rights are not owned by the respective governments. Since the subsurface rights are not divided into small parcels it is easier to apply a unit plan.

The poor showing in production through the unit plans in the United States is natural. It would be expected if they were more prevalent. In the first place there is a greater division of property rights in the United States, making it more difficult. Most projects are not more than two years old. During this period the industry has been afflicted with a more or less degree of overproduction. One of the chief purposes of unit operation is to control production. Most of these plans are being carried out by strong companies, therefore, it is reasonable that production would be reduced to a minimum on unit operated properties.

Mr. Jensen's report for California[9] states there are five pools in that state where there is full unit operation. There are approximately fifty-seven wells in these pools with an approximate average daily production of 930 barrels. There is another property mentioned in the report having approximately one hundred wells with an estimated average daily production of 7,000 barrels. This structure is entirely covered by one operator although the land ownership is divided.

The report of F. E. Wood on the Rocky mountain district states there are in this district fifteen unit and ten near-unit pools. Mr. Wood has tabulated a saving of $20,752,000 in production and development costs in seven unit and near-unit pools. His conclusion is that unit operation is highly profitable and justified from demonstrated actual savings in development and operating costs alone, without taking into consideration intangible benefits such as saving gas and increasing ultimate recovery. Mr. Wood estimates the savings in the Salt creek field alone in developing and operating costs to be $11,650,000.

A. W. Ambrose and C. E. Beecher[10] in their report on Oklahoma and Kansas stated that they had received reports on twenty-seven projects in Oklahoma and thirty in Kansas. The aggregate acreage for the projects in Oklahoma was 49,350 and for Kansas 171,240. Most of these were formed in 1929.

9. *Ibid.*
10. *Ibid.*

Some of them, however, would fall under the head of proration as treated in the preceding chapter.

The following conclusions of Ambrose and Beecher were tentatively derived from a study of the reports on these projects:

1. Unitization is growing rapidly as evidenced by the number of units and the larger total acreage now included in units as compared with practically no acreage two years ago.

2. Operators are convinced that unitization is reducing development and operating cost and they anticipate greater reductions as experience is gained in unit operation.

3. Producing units have not been in operation for a sufficient length of time to give any production history from which to estimate the ultimate recovery of oil. However, the general opinion seems to be that more oil will be recovered.

4. In view of the benefits to be derived from unitization, many operators are refusing to carry on wildcat operations unless a unit has been formed. If this attitude continues to grow there will be no large pools developed in Oklahoma and Kansas in the future except under unit control.

This last sentence is more than likely an expression of hope rather than expectation. Big companies have today considerable acreage checkerboarded in wildcat areas. If a discovery well by a wildcatter should open up any of these areas unit operation would be difficult. Big companies are buying acreage today where they think the trend of development will lead in the next few years.

F. H. Lahee [11] in his report on Arkansas, Louisiana, Texas, and New Mexico includes a very good definition of unit operation. He states:

By unit operation, as I understand the term, we mean the development and operation, by one management, of a single entire pool, or reservoir, of petroleum, on a systematic and scientific plan which is best calculated ultimately to extract from the pay sand and bring to the surface of the ground the largest possible amount of oil with the greatest possible total profit. I say "ultimately" advisedly, for "unit operation" further implies conservation, production at a reasonable rate, and reduction of losses to a minimum.

According to Mr. Lahee there are several large blocks of leases in the south Mid-Continent area each under the control of a single company. Technically speaking, these are unit operations. The principal obstacle to unit operation of large blocks controlled by one company is the division of royalty interests. Each wants his property developed and this calls for a drilling program not always compatible with scientific development.

One plan outlined in this report and frequently cited by others as an example of near-unit operation is the project in Van Zandt county in east Texas. The plan put in force after the discovery well was brought in, was formulated in November, 1929. This area of approximately 6,000 acres is controlled by five companies; the Pure Oil Company, the Humble Oil and Refining Company, the Sun Oil Company, the Texas Company, and the Shell Petroleum Company. With the drilling orgy of Powell, Wortham and Mexia still fresh in the memory of the operators, they worked out a plan to bring about a more

11. *Ibid*, p. 168.

orderly development. Their acreage was pooled and the participating companies own percentages in the operations as follows: 81.70, 7.75, 4.51, 3.57, and 2.47 per cent. The company with the larger interest is operating the property. All five companies will share in costs and profits on the basis of their fractional interests.

At first there was some difference of opinion concerning the values of the properties as far from and near to the discovery well. They agreed to operate on an acreage basis the first two years. In the meantime there will have been opportunity for each company to accumulate data for constructing satisfactory production decline curves. A readjustment of the schedule will be made based on the ratio of estimated ultimate productivity of the leases owned by each party to the estimated ultimate recovery of all the leases in the block. Readjustment of costs and profits will be retroactive to the beginning of the new schedule. The owners of the more productive leases by this plan will ultimately reap proportionally greater profits an acre than the owners of the less productive properties. This eliminates one of the chief objections that *pro rata* distribution of profits based only on acreage may reduce the income of the leaseholders who own the most productive tracts.

Secondary Recovery

Under ordinary methods of production considerable oil is left in the sands. The devices used for the recovery of this oil are known as secondary recovery. Three methods are used: Mining where the oil is extracted by tunnelling under the strata where the oil is found and draining it from the sand. The Ranney process of mining oil is the most widely known method although very little mining has been carried on in this country. The second method is the water drive as practiced in the Bradford field in Pennsylvania and New York. The third method is the air or gas drive, usually known as the Smith-Dunn or Marietta process.

In order to carry out any one of these three methods the pools must be organized into engineering units. The mining process and the water drive can be applied in comparatively small units or tracts. But to apply successfully the air or gas drive it is necessary that the whole pool be treated as a unit if the maximum results are to be obtained.

James O. Lewis, formerly petroleum engineer with the United States bureau of mines, stated at the public hearings before the federal oil conservation board[12] that the amount of oil to be recovered by the air and gas drive method will depend largely upon whether the fields are to be operated as units. He estimated that on an 160 acre tract located in a large pool, the independent operator will be fortunate if he gets half as much profits as could

12. Federal oil conservation board, Report of Public Hearings, February 10 and 11, 1926, pp. 49-65.

be obtained from the same property in unit operation, because when pressure is applied to a small property it does not stop at the boundary but goes across carrying the oil with it. For efficient secondary recovery Mr. Lewis advocates that a pool be operated as one property.

Four methods of consolidation have been employed in the old fields of Oklahoma to carry out more efficiently methods of secondary recovery. They are:

1. One interest buys up all the properties.
2. Undivided interests are assigned between the various property owners upon agreed valuation so that each property owner owns *pro rata* and interest in every lease, the pool being operated by agreement by one of the companies.
3. The properties are assigned to a trusteeship and operated in the common interest, the expenses and profits being distributed *pro rata* upon an agreed appraisal of the properties.
4. The properties are exchanged for stock in a new corporation upon an agreed basis.

Pools in Oklahoma where unit operation has been carried out for the purposes of secondary recovery are the Lenapah pool, the Delaware Extension pool, and the Woody pool in Nowata county. The Delaware pool is a narrow field nearly eight miles long and with an average width of less than one mile. Another pool southeast of Nowata was consolidated by the assignment of interests to a trustee with divisions of interest based upon the number of producing wells.

Mr. Lewis's summary of his conclusions in regard to consolidations of secondary pools as a result of his experience as an engineer in the fields of northeastern Oklahoma, are:

The outcome of our efforts towards consolidation has been to convince us that the position we first took was right; first, that it is only rarely natural conditions are such that the individual operator could even approximate the full possible returns by playing a lone hand; second, that while co-operative agreements can greatly improve the situation of all concerned, such agreements can not yield full results and are apt to break down when the need for joint operation is greatest, and third, that the best results can undoubtedly be obtained by pooling all interests and putting them under one competent management. It is clear, however, that complete voluntary pooling of interests is likely to come in but few cases, as there are always a certain number who can not be convinced or, for various reasons, will not be willing to consolidate their interests. In the course of time the owners of old properties may reach the frame of mind in which this can be done after they have had the opportunity to judge for themselves the advantage of consolidation, but I do not think complete unit operation can ever be expected in old properties, unless there is some provision whereby the majority in the field can compel the hold-outs to come in.[13]

The president of the general Mid-Continent Oil and Gas Association[14] early in 1929 appointed a committee to make a survey of the practice of unit development and operation of oil pools and to submit definite suggestions for furthering the practice. The committee consisted of twelve members, six rep-

13. Manuscript of L. C. Snider, etc.
14. Annual Report of the Mid-Continent Oil and Gas Association, 1929.

resented land departments and together constituted the land division; the other six represented legal departments and constituted the legal division.

The function of the land division of the committee was to draw up a report containing suggestions and then turn it over to the legal division who would draw up contract forms incorporating the suggestions of the land division. The land division held a number of conferences for the purpose of interchanging ideas. One open meeting was held to which land department men in general were invited and who participated in the discussion.

The general committee in its report to the president stated there were several obstacles in the way to a successful program. The varied terms and conditions of leases have been a handicap. In addition to the terms of the lease other things mentioned were the attitude of lessors and some operators as to the real meaning of unit operation and its benefits and the custom of lease brokers to sell acreage spreads. However, the brokers are realizing that they can sell undivided interests as readily as they formerly sold separate tracts. The new method really permits the broker to complete his promotion scheme more expeditiously than under the old system.

The rules of practice recommended by the general committee are as follows:[15]

1. The oil pool rather than the individual tract or lease is the natural competitive unit in the oil producing business and all future development should be on this basis.

2. The buying of divided tracts or spreads of acreage as a means of promoting or financing new development projects is inconsistent with and in opposition to unit development.

3. Agreements to contribute dry hole money to procure tests of new prospective areas constitute an antiquated and deleterious practice unless confined to cases where a co-operative agreement has been made to insure orderly development and production when oil is found. The only permissible exception to this rule is in the case where all the conditions are known and only small wells or pools can be expected to result from the drilling. Small wells are defined as those not capable of producing more than one hundred barrels the well a day.

4. The same economic considerations which prohibit the purchase of spreads of acreage and the contribution of dry hole money require also that no new drilling project should be undertaken in checkerboard areas until every effort has been made to unitize or to effect a co-operative agreement even though there is no occasion or request for purchase of spreads or contributions of dry hole money.

5. Complete frankness, mutual confidence and trust are essential to success in the unitization movement. It is therefore recommended that the policy be adopted of revealing to each prospective member of a unitized pool the geological information in possession of each participant therein, including the results of core drilling.

6. The practice of "top-leasing" is regarded as unethical in the oil producing business. Negotiations by strangers to the title to procure leases to take effect in the future are in derogation of the rights of lessees under valid existing leases in that they force drilling and interfere with efforts to unitize or form co-operative agreements.

15. *Ibid*, p. 7.

7. In order to promote the success of the unitization movement by allaying suspicion or refuting rumors as to alleged infractions of the policy against purchase of spreads and contributions of dry hole money, it is suggested that each operator make it an invariable rule to file with a central agency complete reports of exceptions made to rules two and three, together with the reasons therefor, and showing the approval thereof by a chief executive of the company; and that such reports be kept on file and open to inspection by all *bona fide* operators. The practice of also filing with said agency copies of completed unitization contracts and co-operative agreements for distribution would aid in the educational phase of the movement. The logical agency for this purpose in the Mid-Continent field is the Mid-Continent Oil and Gas Association and its various divisional offices.

Recommended Contracts for Unit Operation

The land committee recommended to the legal committee that five types of contracts be drawn in order to meet the varying conditions in different pools. The first form recommended by the land committee provides for purchase of undivided interest in and the operation of a unit operated block of acreage. The second form of contract recommended provides for the operation of checkerboard and spread acreage already owned in severalty. The third form provides for the individual operation by each individual company of the acreage contributed by it to the pool. The fourth form was designed to be used where for any reason unit operation is found to be unattainable, providing for co-operative development and production from such area. The fifth form is to be used where unit operation cannot be otherwise effected because of lack of agreement on relative values and providing for periodical adjustment of interests based upon records of actual production as development shall progress. This provision, as outlined by the committee, may take the form of (a) a simple agreement as between responsible companies; (b) bond to secure the adjustments to be made; (c) a reserve to be built up out of proceeds of the oil with which to effect later adjustments.

The committee form of unit operating contract is a contract entered into by the individuals and corporations owning good and valid merchantable oil and gas mining leases in the area in question. Each party to the contract shall assign his lease or leases to all the others and in turn they shall assign to him an undivided interest in their's. Each party to the contract will have, after all the assignments are made, an undivided interest in the whole area in proportion to the size of the property assigned is to the whole, as the tabulation on page 183 taken from *The Oil and Gas Journal* illustrates for a 640 acre block.[16]

All the parties to the contract submit their abstracts of title and other title papers to an attorney designated in the contract and who shall be known as the examining party who shall examine the papers without charge. This eliminates a considerable loss in time when the attorneys representing all the parties to the contract examine titles of all the others. The opinions of the examining party shall be conclusive and binding. If any title is rejected this

16. *The Oil and Gas Journal,* July 11, 1929, p. 146.

THE PLAN ILLUSTRATED

Name of Operator	Acres Contributed by each operator	Fraction of entire block that each operator contributes
A	80	2/16
B	40	1/16
C	40	1/16
D	80	2/16
E	80	2/16
F	160	4/16
G	160	4/16
	640	16/16

Fractional working interests in his eighty-acre lease that (A) assigns to the other operators.

2/16 interest in eighty acres retained by (A) equivalent to ten acres
1/16 to (B) equivalent to five acres
1/16 to (C) equivalent to five acres
2/16 to (D) equivalent to ten acres
2/16 to (E) equivalent to ten acres
4/16 to (F) equivalent to twenty acres
4/16 to (G) equivalent to twenty acres

eighty acres

Fractional working interests in the other leases that their owners assign to (A)

2/16 interest in eighty acres retained by (A) equivalent to ten acres
2/16 of (B's) forty acres equivalent to five acres
2/16 of (C's) forty acres equivalent to five acres
2/16 of (D's) eighty acres equivalent to ten acres
2/16 of (E's) eighty acres equivalent to ten acres
2/16 of (F's) 160 acres equivalent to twenty acres
2/16 of (G's) 160 acres equivalent to twenty acres

eighty acres

reduces the proportional interest of the owner of the lease. Until these titles are examined and passed each party to the contract must keep up his rentals and other obligations on his respective interests.

The agreement remains in force for the full term of any and all the leases in the unit operated area and any renewal or extension thereof whether there is production or not. It is terminated only by unanimous consent of the parties to the contract. Each party to the contract proportionally shares in the costs and profits.

An advisory committee is appointed consisting of a representative of each of the parties to the contract. Each representative has a vote in the proportion

the interest he represents has to the whole. It is the duty of this committee to appoint one of their number as operator. One or more additional operators may be appointed after the completion of the first well. This committee passes upon the operator's advance estimate of costs and expenditures. They approve or disapprove any proposed expenditures of the operator in excess of an agreed sum written in the contract. They determine the extent of drilling operations and developments to be carried on by the operator. They appoint auditors and inspectors to check up the accounts of the operator, statements of costs and expenditures. The disposal of surplus supplies and materials is supervised by this committee.

The operator has full control and under the terms of the contract conducts and manages the ownership, operation and development of the area for the production of oil and gas for the joint account of all. The operator must see that the requirements of the workmen's compensation act are complied with and to take out the necessary insurance to protect the parties to the contract from any suits arising out of accidents, etc.

The parties to the contract have the privilege of receiving in kind their proportionate share of the oil and gas produced. If one of the signatories to the contract does not let the operator know what his election is in regard to the disposal of his share of the oil and gas, it may be sold at the posted market price. All wells drilled in the area must be drilled on a competitive contract basis at the usual rates prevailing in the vicinity.

The operator must pay the rentals and royalties on the leases. He must also pay the wages, material costs, for equipment, supplies and other things needed for the development of the property. No one shall receive a salary whose rank is above that of field superintendent. He must also attend to the payment of all taxes against the property. Before the first of each month he must give to the parties to the contract an itemized estimate of the costs for the succeeding month. On or before the twenty-fifth day of each month he must send each a bill of his share of the costs for the preceding month. Provisions are made in the contract for the non-payment of the *pro rata* costs by any of the parties to the contract.

No assignment, mortgage or any other conveyance may be made by any of the parties unless it is for an undivided interest, for which an assignment may be made. However, if a person not already a party to the contract is making a bid for the undivided interest the other parties to the contract must be offered the refusal at the price bid and given ten days to exercise their option. No lease may be surrendered unless the majority of the committee consents to it. The liabilities of the parties to the contract are several and not joint or collective. All of the rules and provisions of this contract are made subject to all valid rules and regulations of any duly constituted authority hav-

ing jurisdiction in the premises. Attached to the contract is a legal description of all the lands involved in the unit operated area.

The trustee form of unit development contract is a contract made between a trustee designated for the purpose, on the one side, and the owners of the properties involved on the other. They assign to the trustee without warranty of title all of their mineral rights and oil and gas leases. Such mineral rights and leases as well as all extensions and renewals are taken in the name of and held by the trustee for the benefit of the owners in proportion to the acreage assigned by each is to the total acreage assigned by all the owners. The trustee in no event is liable for defective titles or errors in examination and approval of the titles. A title once accepted by the trustee is taken at the risk of all parties to the contract. Within a specified number of days from the approval of a well location by the interested parties the trustee must begin a well according to prescribed specifications. The drilling contractor must carry workmen's compensation insurance and public liability insurance. Should the test well produce oil and/or gas in paying quantities the trustee has the management of further operations. New wells and other construction must be done with the consent of a majority of the interested owners. The trustee is required to comply with the express and implied obligations of the respective leases and grants but at all times he is protected from personal liability. The trustee must pay for all expenses incurred in the operations including insurance, taxes, etc., however, if suit is brought against him he is required to defend it, but for the account and risk of the owners of the leases and mineral rights.

The respective owners may take their proportionate share of oil and gas in kind. If they do not exercise their option it is sold by the trustee under the usual form of division orders. The parties to the contract made with the trustee severally own their respective interests and each is severally liable for his proportionate part of all obligations arising out of the trustee's operations as such.

The trustee must render an accounting at the close of each month on the condition of the properties and in turn he is given a lien on the interests of each of the owners to secure payment of their part of the costs. If a lease covered by this agreement has less than a specified number of months within which drilling must be commenced to prevent its termination or expiration, upon the request of a majority of the parties the lease shall be renewed by the trustee at the expense of the original owner. The trustee has the power to dispose of new and second hand surplus material. The contract continues as long as oil and gas are produced from the properties and continues as long as the oil and gas leases and mineral rights or renewals or extensions thereof remain in force.

Should the trustee cease to own a specified per cent of the interests in this

contract, then upon thirty days notice by a majority in interest he must assign all interest as trustee to whom a majority designate as his successor.

The adjustment form of unit development contract is a contract entered into by two or more corporations on the one side owning a given number of oil and gas leases and mineral rights on a given area and a corporation on the other side known as the second party. An interchange of assignments is made whereby each party to the contract assigns his properties for an undivided interest in the whole in the proportion his property bears to the whole. As in the other forms of contracts outlined above the assignments and undivided interests are distributed on an acreage basis.

This division of interests is tentative and continues for a period of two and one-half years when an adjustment is made in the interests each has in the joint acreage. The adjustment is based upon the ultimate productivity of these leases arrived at by the consideration of all evidence thereon then available. The interest of each party is adjusted according to the ratio the ultimate production of his property bears to the ultimate production of the whole. Provisions are made in one contract for the selection of petroleum engineers who will make the re-evaluation of these leases. If no agreement can be reached by the engineers who are to make the re-evaluation or upon their results it is ultimately left to the director of the United States geological survey. The division of interests made by him shall be binding upon all parties to the contract. In like manner, another readjustment is made in five years. After each period of readjustment of values, the owners of the leases that have been overestimated reimburse those whose leases have been undervalued. The adjustments are made on the basis of the prevailing prices in the Mid-Continent field at the time.

If production is found in sands at lower depths adjustments are made on an acreage basis for the first two and one half period, the same as in the upper sand. Separate accounts are kept for this production. At the end of two and one-half years and also at the end of five years readjustments are made along the same lines as outlined above for the upper sand.

The details of administration of the unit operated property is much like that of the two other contracts. The second party charges to the joint account all costs and expenses of operation. The distribution of the proceeds, whether in kind of in money from the sale of oil and gas, is much the same as in the contracts outlined above. If any party desires to dispose of his interests he is bound to give the other interested parties the refusal of the offer made to him by an outsider. These contracts are in the nature of a mining partnership. One partner can dispose of his interest without dissolving the partnership.

If any issue arises between the parties of the first part and the party of the second part in regard to the construing of the contract or in reference to accounting, the matter is submitted to representatives of other first parties.

In the event they decide against the second party the matter in disagreement may be submitted to a board of three arbitrators. The parties of the first part select one arbitrator, the second party selects one, and the two selected choose the third. The decision rendered by a majority of this arbitration board shall be binding on all parties concerned. However, matters affecting the property rights of the parties of the first part are not to be submitted to a board of arbitration. The second party has exclusive control over operations according to the contract. No question shall be submitted to the board of arbitration that would alter this power.

This agreement does not go into effect until it has been executed by the duly authorized representatives of each of the parties concerned and it shall remain in effect during the life of each and every oil and gas lease covered by the agreement and the life of any extensions and renewals made to these leases, and also until all materials, supplies, equipment, etc., have been salvaged and disposed and final settlement made.

The last type of contract drawn up by the committee of the Mid-Continent Oil and Gas Association is a form for agreement for co-operative development and operation. This form is designed to be used where a complete unit program cannot be carried out. It is different from a proration agreement because the latter is only an agreement to curtail the amount of production but does not necessarily include any agreement for co-operative development of a given area.

The consideration in this contract is one dollar including the mutual covenants entered into by all the persons interested. The consideration in the three preceding ones outlined is an inter-change of assignments where a party to the contract assigns his separate interest for a *pro rata* undivided interest in the whole area involved. The purposes of this contract are more strongly emphasized than in the others. The four purposes mentioned in the body of the contract are: A more economical development of the area involved, the conservation of gas pressure and its equitable distribution and use in producing the recoverable oil, the greatest possible ultimate recovery of oil and gas from the area described, and the conservation of oil and gas in the area and the prevention of waste attendant upon overproduction.

According to the terms of this agreement no well shall be located nearer than a specified number of feet to an outside boundary line of a tract or lease unless the parties by unanimous agreement arrange a drilling plan for the area which plan, on account of the irregular shape or size of the individual tracts or leases, or the necessity of conserving or distributing gas pressure or other practical reasons necessary to the plan, shall make an exception.

This agreement states that the initial producing well and each well thereafter drilled which shall be located a specified fraction of a mile, or more, from the nearest producing well, when dry hole contributions equal twenty-five per

cent of the estimated cost thereof shall have been agreed to, shall each be designated a key well and shall be shut in not to exceed fifty barrels a day for a period equal to the average time required to drill a well in that locality to the sand from which said key well may be producing. The following schedule of distances and shut-in time shall be applied to key wells in the area involved.

The key well schedule follows:

Where average drilling time is	*The key well distance from production is*	*Time during which well is curtailed in*
60 days or more and less than 90 days	One half mile	Same as drilling time
90 days or more and less than 120 days	Five-eighths mile	Same as drilling time
120 days or more and less than 150 days	Three-fourths mile	Same as drilling time
150 days or more	One mile	Same as drilling time

Provision is made in this agreement for a curtailment or proration of production to the same proportion of the potential production of the wells as fixed in the agreement for all the wells in the area as a whole.

There is also a provision made for the appointment of a committee, known as the operators' committee, which shall represent all the parties to the contract, and shall make decisions by majority vote on all matters arising in the development and operation of the described area. Majority vote is construed to mean a majority in numbers of all members constituting the committee and also a majority of all the acreage constituting the described area. It is the duty of this committee to formulate a plan for the development of the area and to submit it in writing to all the parties represented in the contract. If there is unanimous consent to the plan then it is attached to this contract. Failure to obtain unanimous consent does not abrogate this contract. If some of the leases are irregular in shape and size so that their owners may not be able to conform to the plans presented then provision is made that suggestion be made to the owners to consolidate these properties with adjoining property. Unlike the other agreement outlined above this agreement is made for a specified number of years.

Although it has been five years since H. L. Doherty first proposed a unit plan of operation the agreements that have been made to put unit operation in force are very recent. An insufficient amount of time has elapsed to make an appraisal of the benefits. The prevailing sentiment in the industry, however, is very favorable to the idea. Practically all the major companies, Standard and independent, are in sympathy with it and several of them have entered into unit operation agreements, and most of those opposed are royalty owners and smaller independent producers.

The principal advantages and benefits set forth by the proponents of unit operation may be summarized as follows: Decreased expense of development and operation because competitive exploitation has been eliminated, thus reducing the number of wells and in turn reducing the costs of operation and overhead; increased recovery and more complete utilization through the application of scientific methods; better prices through distressed selling. Under the system of competitive drilling there is frequently a condition of overproduction, resulting in lower prices. This condition would be eliminated through more orderly drilling under a unit plan. Greater ultimate recovery of oil may be realized through the conservation of gas. The small operator will be benefited because through this plan supply may be balanced with demand, whereas under a competitive system, where it is the survival of the strongest, the small operator is the first to suffer. This argument may also be used for proration.

The principal arguments against unit operation are: It may bring stagnation through the elimination of competition, thus destroying a zeal for efficiency and stopping improvements in technique; shortsighted management might not take advantage of the opportunities which would result in a loss to those who entrusted their properties to their care. Improved extraction methods increase costs. Probably what the opponents to unit operation mean by improved extraction methods is new methods. The methods would not be improved if they increased costs. Also what they mean is methods used in such a program would increase costs. Royalty owners oppose the plan because when the leases are pooled this does not mean always that the interests of the royalty owners are pooled. If the leases run for ten years a well may be drilled on one of the leases and the adjoining leases may not be drilled for a period of ten years. In the meantime oil has been drained from their land.

It has also been claimed that unit operation is illegal because it is a combination in restraint of trade. This phase of the problem will be discussed in the next chapter which will take up the relations between government and the industry.

CHAPTER TEN

THE OIL INDUSTRY AND GOVERNMENT

THE contacts between the oil industry in the United States and state and federal governments have not all been happy ones. The litigation that resulted in the dissolution of the Standard Oil Company in 1911 by the United States supreme court, litigation in the courts of many states, investigations by state and federal authorities, have served to make the industry more or less fearful of governmental authority. Anything that suggests government control created a furor of opposition by those in the industry. The spokesmen for the industry until recently have all insisted on the policy of *laissez faire*. When government interference was suggested the bones of the classical economists were rattled. Quoting Harry H. Smith, secretary of the Mid-Continent Oil and Gas Association.[1]

The discovery of new sources of supply and improvement in methods of production, distribution and utilization have always set at naught the seemingly logical arguments of the alarmists by expanding the volume and multiplying the want-satisfying-power of available supplies, even though necessity has been the spur and increased price the vehicle of such notable accomplishments. But as Adam Smith so ably argued in his *Wealth of Nations,* it has been *self interest,* not the *action of government,* that has brought about the improvement of economic conditions.

The attitude of the industry toward the government during the last five years has changed considerably. It has changed from an attitude of fear to an attitude of co-operation. The leaders have realized and have come to appreciate the fact that the industry is "affected with public interest." It is affected with public interest because the industry provides our machine civilization with light, heat, power, and lubricants. Without petroleum the American standard of living could not be maintained. There is a public interest in the fact that the supply, whatever it is, is limited. James A. Veasey, counsel for the Carter Oil Company, stated the situation clearly when he said:[2]

The leaders of the industry should be impressed with the fact that, after all, their supreme duty is to the American public and the American government. If the industry, on its own responsibility and in its own way, shall fail to put its house in order, particularly in relation to the two basic problems which now confront it, there will be an insistent—perhaps an irresistible—demand for legislative control. If this unhappy moment shall ever come, the all absorbing question will be the degree in which the nation or the states may regulate the drilling and operation of oil wells.

The spokesmen for the industry are emphatic in their statements that

1. Memorandum for Committee of American Petroleum Institute on Information for Federal Oil Conservation Board, March, 1925, manuscript.
2. James A. Veasey, "Constitutional Obstacles to Oil Law," *The Oil and Gas Journal,* September 1, 1927, p. 32.

the oil business should not be subjected to the legal rules of a public utility. There is much in common, however, from an economic viewpoint, between the petroleum industry and public utilities. The notion of a public utility is made up of two ideas: the idea of monopoly and the idea of necessity.[3] There is no monopoly in the petroleum industry today. The production of petroleum never was a natural, or a capitalistic, monopoly. However, if there were any concerted effort on the part of the industry, either with or without the co-operation of the government, to curtail or to control production the idea of monopoly would persist in the public mind. The idea of necessity is so apparent it needs no comment. If petroleum were not a necessity it would have been impossible to build up an eleven billion dollar industry within the allotted period of a man's life, three score years and ten. Petroleum now is an essential of life. As Professor Glaeser states, the industrial and political factors, as mirrored in public opinion, will determine whether or not an industry is a public utility. Specifically, the factors are the number and kinds of industries classified as public utilities:

> The elaboration of the system of rights and duties which make up the institution; the regulating agencies and instrumentalities employed (whether legal rules and degrees of courts, or the charters, special franchises and statutes of legislatures); and the subordinate administrative standards which are evolved in practice. The trend in the development and application of the institution will be a resultant of the amount of social inertia, of the pressure of the economic environment and of the influence of intellectual progress. Special attention should be directed to these dynamic factors; the growth and extension of monopoly, war and other conditions creating special emergencies, the movement for conservation of natural resources, and the movement for public ownership.[4]

Although the nature of the petroleum industry is such as would lend itself to be a public utility there is practically no demand on the part of the public to create it as such nor any disposition on the part of the government, state and national, to take any steps in that direction. Its leaders are opposed to any steps in this direction because they do not want to be subject to any form of governmental control because of the "red tape" involved and the restrictions that might be placed upon their liberty. The arguments advanced against such a move would be that the industry is too individualistic and too technical.

When President Coolidge appointed the federal oil conservation board in 1924 there was a great feeling of apprehension within the industry lest this was a move toward some form of governmental control. There was a feeling of uncertainty for several months. This feeling gradually gave way to one of candor and of co-operation. The industry knew there were certain uneconomic practices in developing producing properties and that these prac-

3. Martin G. Glaeser, *Outlines of Public Utility Economics,* The MacMillan Company, 1927, p. 178.
4. *Ibid,* p. 179.

tices were beyond its control. They also knew they were not altogether responsible for these practices. They were the result, as explained in Chapter IV, of court decisions beginning with the analogy of percolating waters and wild game, and the development of oil and gas rights since that time. Because these practices were beyond their control the leaders in the industry realized that if they continued unaided by public authority that certain developments were likely to take place that would have far reaching consequences. Therefore, they have welcomed its assistance in the solution of its economic problems.

The development of the petroleum industry, in one respect, has been similar to the earlier stages in the development of American railroads. At first the railroads were given free rein and complete freedom. Competition brought about a condition of chaos that necessitated governmental control. The course of events in the petroleum industry has seemed to lead in the same direction and unless aided by the government the path apparently will lead to disaster. It is not intended here to infer that the larger companies are on the verge of bankruptcy and that the smaller companies are on the brink of ruin. Petroleum is a non-reproducible resource whose supply is unknown. There is an apparent abundance today. Production and consumption are increasing at a faster rate. There is fear that if conditions continue as they are, an irreplaceable resource will be dissipated which will result in undermining vast structures which the industry has built up, as well as result in attendant social losses. For this reason it is important that co-operation with the government be cultivated.

There is a greater recognition on the part of the government today of the competitive struggle within the industry, more knowledge of its economic hazards, and a growing appreciation of the services of the industry to the public. The federal oil conservation board has accumulated considerable data through questionnaires and public hearings and has attempted to weigh the facts in a scientific manner. Its reports have been free from criticism but at the same time it has attempted to promote better practices for the future. The department of justice has shown no disposition on its part to interfere with the courses of action that have been taken in regard to conservation although it has been keeping in touch with the work of the federal oil conservation board and the co-operative measures encouraged by it. The federal trade commission has had no important investigation underway at the present time that would seriously disrupt the industry. The last report made by the commission, *Prices, Profits and Competition of the Petroleum Industry* was not unfavorable. The interstate commerce commission has made no adverse conclusions, as, for example, that gasoline is a luxury and can therefore be made to bear proportionately high transportation costs. The

department of commerce has extended its useful service to the publication of trade information covering foreign petroleum statistics. A number of federal bureaus such as the bureau of mines and the bureau of standards have been at work on problems of a scientific nature in co-operation with the petroleum industry which have and will result in a great benefit to it.

Not only has the federal government shown a co-operative spirit but the various state governments have done likewise. Through the state corporation commissions, or other agencies, the states have co-operated in curtailment programs, and have furnished engineering services looking to the conservation of the petroleum resources.

The problem of the petroleum industry today is one of controlling supply. The purpose in doing so is to prevent economic waste and at the same time insure profits to those engaged in the business. Any effort to restrict production in spite of the general co-operative spirit existing between the industry and the government is faced with a dilemma. If the industry initiates a movement to restrict production it is subject to the anti-trust laws for acting in restraint of trade. If the government initiates the movement it is likely to be unconstitutional on the ground that the person is deprived of property without due process of law. These phases of the problem will be taken up in order.

The two principal devices for regulating production resorted to by the industry, discussed in the last two chapters, are proration and unit operation. Unit operation has received more opposition than proration. However, Wade H. James, president of the Mid-Continent Royalty Owners' Association, has said:[5]

The royalty owners associations, comprising the Oklahoma-Kansas division, the Texas division, and the Louisiana-Arkansas division, have consented to the proration program put in force in the various states by the major producing oil companies, although the plan is obviously in violation of the laws in restraint of trade in the various states and in all instances violates the covenants in oil and gas mining leases requiring diligent operation of the leasehold estate.

A. L. Haase, publisher of the *Oil Producer* of Tulsa, has written state officials in Oklahoma, Kansas and Texas asking them to advise oil companies of the true status of the matter in regard to the legality of unit operation plans. Mr. Haase said:[6]

There is a plan entitled "unit system of development" being carried into effect by some oil companies on the theory that this is an efficiency measure to regulate and reduce the indiscriminate drilling of wells for oil. It is in effect a plan that comprises illegitimate combinations in restraint of trade by agreement of producers of oil. Your state code specifically prohibits such combinations . . . . . We have no complaint to make of the moral aspects of such plan. The people of your state and the state itself have a great deal to do with the physical results of such plan.

5. *Daily Oklahoman,* March 27, 1930.
6. *Ibid,* March 24, 1930.

The published, accepted and ratified rules pertaining to the unit plan of development call for all companies to refrain from the giving of "dry-hole money" to promote tests on wildcat acreage. This is a business decision which should rest with each company solely, and dependent on the value which such test might have on land or leases owned by a contributing company. The rules go further, they request all oil companies to refrain from buying or contracting, to buy any leases in a proposed wildcat test block, unless the oil company can purchase a fractional part of the whole block in company with other oil companies doing likewise and appoint one member of such syndicate as operator to drill such wells as are needed to develop the possibilities of the acreage, each member to contribute his share of the expense and sharing proportionately in the revenues derived. . . .

We submit that the unit plan of development, ratified for its members by the Mid-Continent Oil and Gas Association and by the American Petroleum Institute for its members, by segregating control of all new oil pools into the hands of but few major companies is against public policy and call upon you to notify the participants in any such combination.

Legal Phases of Unit Operation

It seems to be the consensus of opinion among oil company attorneys that the federal anti-trust laws cannot be applied to agreements to curtail production in any of the states. It makes no difference whether these agreements are proration or unit operation schemes. The child labor decision, Hammer vs. Dagenhart,[7] is the basis for this opinion. From a social viewpoint the child labor law prohibiting the entrance of goods made by child labor under certain conditions into interstate commerce is desirable. The general welfare, peace, progress, and happiness of society would have been promoted by this law. All the courts recognized its social benefits but the majority opinion declared it unconstitutional. The court said:

The constitutional grant of power to congress over the subject of interstate commerce was to enable it to regulate such commerce, and not to give it authority to control the states in the exercise of the police power over local trade and manufacture.

Had this law been upheld it would have in the opinion of the court vested too much power in the federal government. It is the function of the supreme court to protect the states in their rights as it is to protect the federal government from encroachment upon its powers by the states.

The court also said:[8]

The grant of power to congress over the subject of interstate commerce was to enable it to regulate such commerce and not to give it authority to control the states in their exercise of the police power over local trade and manufacturing. The grant of authority over purely federal matter was not intended to destroy the local power always existing and carefully reserved to the states in the tenth amendment to the constitution. Police regulations relating to the internal trade and affairs of the states have been uniformly recognized as within such control. There should be limitations upon the right to employ children in mines and factories in the interest of their own and public welfare all will admit. It may be desirable that such laws be uniform, but our federal government is one of the enumerated powers and the maintenance of the authority of the states over matters purely local is as essential to the preservation of our institutions as is the conservation of the supremacy of the federal

7. 247 U. S. 251; 62 Law Ed. 901.
8. *Ibid.*

government, in all matters intrusted to the nation by the federal constitution. The power of the states to regulate their purely internal affairs by such laws as seem wise to the local authority, is inherent and has never been surrendered to the general government.

Thus the act, in a twofold sense, is repugnent to the constitution. It not only transcends the authority delegated to congress over commerce, but also, exerts a power as to purely local matters to which the federal authority does not extend.

This opinion of the supreme court came nearly being the other way. It was a five to four decision. If the issue ever came up again before the supreme court with a changed personnel it is just as likely that the decision would be reversed. Mr. Justice Holmes in his dissenting opinion said:

The act does not meddle with anything belonging to the states. They may regulate their internal affairs and the domestic commerce as they like. But when they seek to send their products across the state line they are no longer within their rights. If there were no constitution and no congress, their power to cross the line would depend upon their neighbors. Under the constitution such commerce belongs, not to the states, but to congress to regulate. It may carry out its views of public policy whatever indirect effect they may have upon the activities of the states. Instead of being encountered by a prohibitive tariff at her boundaries, the state encounters the public policy of the United States which it is for congress to express. The public policy of the United States is shaped with a view to the benefit of the nation as a whole. If, as has been the case within the memory of men still living, a state should take a different view of the propriety of sustaining a lottery from that which generally prevails, I cannot believe that the fact would require a different decision from that reached in Champion vs. Ames. Yet in that case, it would be said with quite as much force as in this, that congress was attempting to intermeddle with the state's domestic affairs. The national welfare, as understood by congress, may require a different attitude within its sphere from that of some self-seeking state. It seems to me entirely constitutional for congress to enforce its understanding by all the means at its command.[9]

Other cases may be cited to support this contention. In United Mine Workers of America vs. Coronado Coal Company[10] the court said that coal mining is not interstate commerce and the power of congress does not extend to its regulation as such. The supreme court of the United States also said in Oliver Mining Company vs. Lord that mining is not interstate commerce but like manufacturing is a local business, subject to local regulation and taxation.[11]

It may be argued that by the concept of inherent power in the federal government arising from sovereignty that federal control could be placed over the drilling of oil wells in the respective states.[12] In answer to this argument oil attorneys cite the case of Kansas vs. Colorado,[13] wherein the state of Kansas, in an original proceeding in the United States supreme court, sought to enjoin the diversion of the water of the Arkansas river by the state of Colorado, where the latter state was appropriating the water for the reclamation of

9. *Ibid.*
10. 259 U. S. 407.
11. 262 U. S. 171.
12. James A. Veasey, *op. cit.*, p. 32.
13. 206 U. S. 46; 27 Supreme Court 655; 51 Law Ed. 956.

arid lands, the United States government sought to intervene. The federal government conceded that the Arkansas river was not navigable in that region and that the United States had no power to act under the interstate commerce clause. It also conceded that there was no specific, express, or implied power in the federal constitution which could be referred to as a basis for intervention. The counsel for the government based their case on these two propositions: That the subject matter could be dealt with effectively by the federal government while it could not be dealt with by the states; and that the necessary power resulted to the United States as an attribute of its sovereignty, that is, its power to govern for the general welfare.

Mr. Justice Brewer gave a very illuminating interpretation of the tenth amendment to the constitution when he handed down the opinion in this case. He said that the principal purpose of the tenth amendment,

> was not the distribution of power between the United States and the states but a reservation to the people of all the powers not granted. The powers affecting the internal affairs of the states, not granted to the United States by the constitution, nor prohibited by it to the states, are reserved to the states respectively, and all powers of a national character, which are not delegated to the national government by the constitution, are reserved to the people of the United States.

The doctrine laid down in this decision—that all powers rest in the states unless expressly delegated to the federal government—sets at rest any theory that the federal government has authority from sovereignty alone to control drilling of oil wells.

When a committee of the American Petroleum Institute at Houston, Texas, March 16, 1929, proposed that those engaged in the production of petroleum agree to limit production in certain areas in 1929 to the amount produced in 1928, provided that such action be first approved by the federal oil conservation board and by the authorities in the states affected, Dr. Ray Lyman Wilbur as chairman of the conservation board wrote to William D. Mitchell, attorney general of the United States, for his opinion in regard to the board's power to approve the proposed agreement and what, if any, effect such approval might have in relieving the parties to the proposed agreement from the acts of congress forbidding agreements in restraint of interstate commerce and if the proposed agreement would violate the anti-trust laws of the United States.

Attorney General Mitchell's letter in reply, dated March 15, 1929, was in part:

> The federal oil conservation board was constituted December 19, 1924, by an executive order naming the secretaries of war, navy, interior and commerce. There was no act of congress then in force defining the duties or powers of the board and there has been no legislation since, dealing with the board, excepting appropriation acts, commencing with the act of January 20, 1925, appropriating funds for the expenses of the board.
>
> It is clear that congress has not given the board any power to grant to any persons

immunity from the operation of acts of congress prohibiting agreements in restraint of interstate commerce and that the board has no authority to approve any action which is contrary to an act of Congress or to the anti-trust laws of any state; and that no action taken by the board would have the effect of relieving parties to such an agreement from the operation of the anti-trust laws of the United States and the states. The proceedings of the American Petroleum Institute indicate that the purpose of submitting the proposed agreement to the federal oil conservation board for approval is to obtain a sanction from the federal government which may operate to make the parties to the agreement immune from the operation of the anti-trust laws. For the federal conservation board to grant approval under such circumstances would be assuming authority which it does not have.

The board's only duties are to investigate and study for the purpose of recommending methods of conservation, and not with the intent that its action in approving or disapproving any plan would have any legal effect on the validity of the plan proposed. As the powers of the board are limited in this way, the question whether the proposed agreement would violate the anti-trust laws of the United States is apparently not a question arising in one of the executive departments on which the attorney general is authorized by law to give an opinion. Furthermore, it is not the practice of attorneys general to give opinions as to whether proposed action by private persons would violate the laws of the United States.

The proceedings of the Petroleum Institute make it clear that its members already realize that under existing laws such an agreement could not safely be made without the sanction of some officials of the United States authorized to give it and, as I have already pointed out, no such authority exists.

The attorney general could take no other stand. It is clear that the federal oil conservation board has no authority to take the industry from under the control of the anti-trust laws of the United States. This does not imply necessarily that such agreements are subject to the federal anti-trust laws. The attorney general said that the proceedings of the Petroleum Institute make it clear that its members already realize that under existing laws such an agreement could not safely be made without the sanction of some official authorized to give it and no such authority exists. The attitude of those who drew up the resolution was evidently to show that the industry did not want to violate any of the anti-trust laws of the United States and put themselves on record to that effect. They did not ask immunity. The leading companies have had previous experience in coming in conflict with the anti-trust laws and they did not care to repeat the experience. The safest thing was to inquire what was the attitude of the government. Attorney General Mitchell could have said nothing else. No government agency has authority to exempt them from prosecution under the law. However, no inference can be drawn from the letter that such agreements would be in restraint of trade. The secretary of the interior is highly in sympathy with such programs in the interest of conservation. He is doing all he can in his official capacity to encourage conservation by these methods. Should the attorney general decide that they are in violation of the anti-trust laws there would be a conflict between two branches of the executive department of government.

When President Coolidge created the federal oil conservation board he requested the board to study the government's responsibility and enlist the full co-operation of the oil industry in an investigation to determine actual conditions. In keeping with President Coolidge's request the federal oil conservation board appointed a committee of nine from the American Bar Association, three attorneys to represent the industry, three to represent the government, and three to represent the public, to study the problem of conserving the oil resources of the country.

The conclusions of the committee in its report to the federal oil conservation board are as follows:[14]

The inquiry of your committee has involved serious economic questions as well as debatable propositions of law. We are convinced that the American petroleum industry will never find its proper place in our economic structure until it solves the problems that arise from the competitive drilling and operation of oil and gas pools. Whether that is to be accomplished by voluntary action in the industry or by the compulsion of law is yet to be determined. After an extended inquiry into the two possibilities, we have reached the conclusion that, by force of circumstances entirely beyond the control of the industry, comprehensive voluntary action is improbable if not impossible. Upon the basis of this conviction your committee proposes one compulsory measure. Beyond this, your committee can not go. We understand that this report is to be filed with the federal oil conservation board, the American Petroleum Institute, and the local oil and gas associations in the important oil producing states. Whether these agencies will accept all or any of the suggestions made in this report does not concern the committee. We do feel, however, that with a presentation of this report, the committee has discharged its full duty.

The compulsory measure recommended by this committee was to compel the co-operative development and operation of the entire pool by coercing the minority operators to enter into the agreement. The intent of this suggested law included more than the control of drilling and the rate of production from existing wells. It also presupposed the application of a number of operating methods, both scientific and practical, to each separate property in the pool for the major purposes of bringing about orderly production, through the efficient use of gas energy, to enlarge the ultimate production. The purpose of this suggestion was to eliminate competitive drilling. This plan, however, was restricted to new pools and did not take into account the emergency of overproduction or threatened overproduction that might characterize a number of old pools. Unanimous agreement of all the operators was suggested to meet these conditions. State legislation was recommended to take this kind of agreements from under the penalties of the anti-trust laws. The committee, also, suggested that compulsion might be extended to old as well as new fields when a condition of overproduction existed.

The committee were of the opinion that the federal and state anti-trust

14. Report III of the federal oil conservation board to the president of the United States, February 25, 1929, p. 40.

laws were either a real or pretended obstacle to the making of agreements of this character and suggested bills to remedy this condition. In the formulation of these bills the committee acted upon the assumption that agreements among oil operators in the same oil and gas pool for the purpose of co-operative development would assist in solving the question of competitive development of oil and gas pools; that the industry should have the same economic advantage that is accorded to all other industrial enterprises in being given the privilege of stopping or limiting production during periods of overproduction; that relief from the state anti-trust laws is necessary to protect it in these agreements. The committee maintained that if the anti-trust laws were an obstacle in the way of conservation they should be removed. Although several months have passed since the report of the committee of nine no state has followed their suggestion and passed an act like the ones recommended.

Henry L. Doherty, in his testimony before the federal oil conservation board, took exception to the stand of Charles Evans Hughes,[15] representing the American Petroleum Institute, that conservation was a matter of state control. His stand was that the federal government had the authority through its power to provide for national defense. Mr. Doherty's reasons why he thought the federal government has power to legislate regarding the production of oil may be summarized as follows:

1. Because oil is our most important munition of war.
2. It is in imminent danger of being exhausted to the point whereby we would be seriously handicapped in event of war.
3. By changing our laws so that they would conform to the general laws relating to other property, huge ground supplies of oil would naturally be built up, which would be a great protection to us in event of war.
4. The laws that now govern the production of oil are faulty and in violation of natural laws, and make it impossible to avoid waste. By changing our present laws so they would be more in conformity with the laws governing other property, it would be possible to recover much larger quantities of oil and to conserve huge quantities of natural gas which are now wasted.
5. This is the only country in the world that possesses enormous quantities of helium gas, and it is believed by many that this gas will prove to be of vast and increasing importance as a war resource. This helium gas occurs always in association with natural gas, and only by changing our laws relating to the production of gas and oil can this helium gas in every instance be conserved.
6. While, in my opinion, it is undesirable to do more toward the conservation of oil at this time other than to change our laws so that waste may be avoided, nevertheless a future supply of oil from our own country is such a necessary war measure that the federal government should be in the most intimate touch with all matters relating to oil production and to be prepared on short notice to pass other laws aimed to still further conserve our petroleum should the necessity arise.

It is apparent that if any attempt is made to prevent oil companies from carrying out unit operation programs it would have to be done under the laws

15. Federal Oil Conservation Board Hearings, May 27, 1926, p. 63.

of the state in which the program is attempted. Practically all the states have some kind of statute intended to restrict business in restraint of trade. No real test case has ever been made in any state restraining two or more companies from entering upon a unit operation scheme. Injunctions have been filed from time to time as a result of proration agreements in some of the states but no real test case came out of it. Although it is claimed that proration and unit operation agreements are in restraint of trade, as was noted in the above quotations of Mr. Haase and Mr. James, the various state governments through their corporation commissions, or other agencies appointed for the purpose, have really encouraged these agreements in the interest of conservation. In Oklahoma the state corporation commission and in Texas the railroad commission have made every effort through proration orders to curtail production in the interest of conservation. Their authority until recently has never been seriously challenged. The industry has the encouragement and the support of most of the states in these programs.

Since 1878 the oil producing states have from time to time passed conservation laws with special reference to petroleum but it is doubtful if these laws may be applied to compel oil operators to co-operate in any kind of unit operation program. The state of Pennsylvania passed the first oil conservation measure in 1878. New York followed with a law in 1879; Ohio, 1883; West Virginia, 1891; Oklahoma, 1915; and California, a new conservation law in 1929.

The first conservation laws were designed to protect the oil and gas bearing sands from the infiltration of salt water. These laws provided for the casing off of water, the plugging of wells in a specific manner at the time of abandonment, the permission to owners of wells to go on adjacent property of another and plug the well if they fail or neglect to do so. Beginning with about 1886 when Indiana passed a conservation act the intent of the law was changed to prevent the waste of natural gas.

The conservation laws as they now stand with reference to our problem involve three questions:[16] Does the police power regulating the drilling of oil wells rest upon the correlative rights and duties of operators in the same pool, or upon the broader foundation of the general welfare? If the basis of police power is the correlative rights and duties of the operators in a common pool rather than on the social welfare, how far may the regulations go? The question involved is, should the regulations be confined to waste or can they be made to extend to the proportional taking of oil by the operators from a common pool? Can statutory regulations be applied to the taking of gas when such regulations applied to the taking of petroleum would likely

16. James A. Veasey, *op. cit.*, p 32.

be unconstitutional because of the property guarantees of the fifth and fourteenth amendments?

The evolution of the Ohio Oil Company vs. Indiana case and[17] the condition that brought it about will give some clue to the answers. When gas was discovered in Indiana it was an agricultural state. As soon as this resource began to be developed Indiana turned to industrial enterprises and gas as a fuel became the foundation for a large development in manufacturing. In order to conserve this supply of fuel the legislature passed a law prohibiting the transportation of natural gas beyond the boundaries of the state and prohibited its waste by any means whatsoever. The transportation feature of the law was speedily declared unconstitutional by the supreme court of the United States because it interfered with interstate commerce. Indiana met this difficulty, however, by prohibiting the flow of natural gas through pipelines by any other means than by natural pressure. The law also prohibited the burning of natural gas for illuminating purposes in flambeau lights. The courts held that this did not deprive the owners of the gas of their property without due process of law.[18]

The legislature of the state of Indiana passed an act in 1893 which provided that neither oil nor gas should be permitted to flow or escape into the open air for a period longer than two days next after discovery. In 1891 when the gas pressure became so depleted that it was impossible to transport gas to cities in Indiana outside the gas regions the legislature repealed the law prohibiting the transportation of gas through pipelines under pressure. This legislation of the state of Indiana was enacted on the theory an emergency existed and that it was for the welfare and prosperity of the people of that state. This was the attitude taken by the Indiana courts.

After these acts were passed the Ohio Oil Company explored for oil and found it in deeper strata than that in which gas was found. They permitted the gas to go to waste while operating for oil in violation of the state's law. The attorney general brought suit against the company to restrain it from wasting the gas. The oil company based its case upon these points:[19] that it was interested only in the production of oil; that it owned the right to produce oil; that it could not produce oil without wasting gas; that the statute amounted to taking the oil without due process. The court said that there was an analogy between natural gas and wild animals and fish; before the gas was reduced to possession, the state in its sovereign capacity was the proprietor. If this principle were sound the right of the state to regulate the taking of natural gas was unlimited. The notion of the correlative rights and

17. 177 U. S. 190; 20 Supreme Court 576; 44 L. Ed. 729. Also see Veasey, *op. cit.*
18. Townsend vs. State, 147, Ind. 624; 47 N. E. 19; 37 L. R. A. 294.
19. James A. Veasey, *op. cit.*, p. 32.

duties among the operators was ignored. The court based its decision upon the proposition that the statute was designed to promote the public welfare.

When the case reached the United States supreme court the court affirmed the decision of the lower court but on an entirely different ground. The lower courts held that the protection afforded by this law concerns public and not private rights. The welfare of the whole state was concerned. The purpose of this statute was to abate a public nuisance.

The state maintained: The importance of the supply of gas to the people in the gas region and to the people of the whole state; that the gas was in one vast reservoir and that by any one's taking or wasting it reduced the common supply; that the defendant was operating for oil and wasting gas and that if permitted to continue the pressure would be reduced and salt water would encroach upon the formations and destroy the supply. The oil company answered by stating: That it had a right to produce oil by virtue of the leases it owned in that part of the state; since it was engaged in the oil business exclusively it had no way to take care of the gas; that it had to drill through the gas stratum to find oil; that it used the gas coming from its wells to raise the oil and that this was the ordinary method of producing it; that it was impossible to produce the oil without wasting the gas.

The supreme court sustained the decision of the state court, not on the ground, as the lower court had ruled, that it was to abate a public nuisance, but that it was to abate a private nuisance. The court said:[20]

> Viewed, then, as a statute to protect or to prevent the waste of the common property of the surface owners, the law of the state of Indiana which is here attacked because it is asserted that it divested private property without due compensation, in substance, is a statute protecting private property and preventing it from being taken by one of the common owners without regard to the enjoyment of the others. Indeed, the entire argument upon which the attack on the statute must depend involves a dilemma, which is this: If the right of the collective owners of the surface to take from the common fund, and thus reduce a portion of it to possession, does not create a property interest in the common fund, then the statute does not provide for the taking of private property without compensation. If, on the other hand, there be as a consequence of the right of the surface owners to reduce to possession, a right of property in them in and to the substances contained in the common reservoir of supply, then, as a necessary result of the right of property, its indivisible quality, and the peculiar position of the things to which it relates, there must arise the legislative power to protect the right of property from destruction. . . .
>
> In view of the fact that regulations of natural deposits of oil and gas and the right of the owner to take them as an incident of the title in fee to the surface of the earth, as said by the supreme court of Indiana, is ultimately but a regulation of real property, and they must hence be treated as relating to the preservation and protection of rights of an essentially local character. Considering this fact and the peculiar situation of the substances, as well as the character of the rights of surface owners, we cannot say that the statute amounts to a taking of private property, when it is but a regulation by the state of Indiana of a subject which especially comes within its lawful authority.

20. *Ibid.*

To summarize: The supreme court in the Ohio Oil Company case rejected the principle laid down by the supreme court of Ohio when it upheld the police laws on the ground of public welfare and upheld the statute as a proper exercise of the police power to abate a private as distinguished from a public nuisance.

It was shown in Chapter IV that the operator may drill as many wells on the lease as he may choose to drill and locate where he may desire. His lease provides that he must protect his lessor's land from drainage. He is compelled by implication to continue to drill for oil as long as it may be found in paying quantities. He may employ any method to achieve these ends that are available as long as they do not unreasonably injure the rights of his neighbors in the same pool. Excepting the royalties the oil and gas that he may produce belongs to him.[21]

Most of the cases dealing with the correlative rights of owners involve natural gas and not petroleum.[22] This is due to the fact that gas is more migratory than oil. Unlike oil, gas, when found, must either be confined in the reservoir or put to immediate use because it cannot be conveniently stored. Some companies have succeeded in taking oil out of one reservoir and storing it in another but this practice is not general. The courts have protected the correlative rights of gas lessees more so than oil lessees because the dissipation of gas reduces the pressure upon the formation which increases the danger of water flooding the sands. Also by permitting the gas to escape it reduces the common supply.

Mr. Veasey summarizes his opinion on the relationship of the state's police power and the due process clause of the constitution.[23]

This treatment will be entered upon with diffidence because of the complexity of the legal questions that are involved. Standing at the forefront is the overwhelming consideration that there is no fixed or satisfactory standard to determine where the police power of a state ends and where the effective protection of the due process clause begins. The supreme court of the United States is absolutely committed to the doctrine that no definite rule can be laid down to determine the limits of the police power of the states. On the contrary, each case is to be decided upon its own peculiar facts and circumstances. To the extent that definite rules upon the question may be deduced from the decisions, they take this form: (a) Whether a police statute offends, due process entirely depends upon the degree in which the act impairs or interferes with property rights. Under the cases here cited, if a regulation goes too far, and if it interferes too greatly with property rights, the statute must yield to the due process clause. (b) The burden is on the party attacking the the constitutionality of the particular measure to establish the invalidating fact. (c) If a regulatory statute is clearly arbitrary and unreasonable in its infringement upon property rights, it falls within the condemnation of the due process clause. (d) Even if the ultimate purpose to be accomplished by the statute is legitimate, the regulation of property pre-

21. See Chapter IV, p. 46.
22. James A. Veasey, *op. cit.*
23. *Ibid.*

scribed thereby must have a direct, substantial, and reasonable relation thereto. Otherwise, it will offend the due process clause. (e) Late decisions evidence a pronounced tendency on the part of the court toward a closer scrutiny of the factual situation when called upon to determine the constitutionality of a police statute. The court will take judicial notice of the facts showing the public need and will attach decided weight to the opinion of scientists and experts, both in regard to the public necessity for the enactment and its probable effect.

The trend of the conflict between the police powers of the states and the due process clause of the constitution has been in favor of the latter. According to Mr. Veasey, from 1868 to 1912, six per cent of the cases coming before the supreme court of the United States, involving state legislation of a social or economic character were held unconstitutional where the statute was challenged under the due process clause of the fourteenth amendment. Between 1913 and 1920 seven per cent were held unconstitutional. Between 1921 and 1927 twenty-eight per cent were held unconstitutional.

Two schools of thought are represented in the decisions of the supreme court. The conservative minded justices are inclined toward the due process clause of the constitution. The progressive minded judges are inclined the other way to favor the police powers of the states in promoting the public welfare. The recent appointment of Justice Charles E. Hughes to the bench may be construed that the ranks of the conservatives have been held intact, especially, in regard to any litigation that may come up where these issues will be involved as they affect the oil industry. However, in behalf of Mr. Justice Hughes it may be added that a justice never sits in a case in which he has formerly been employed as counsel or with which he has had the slightest relationship. Also, it might be said that a justice does not consider himself bound by any previous opinions, briefs or arguments, but weighs the case before him solely on its merits and on the law as presented and interpreted.

Judge Hughes, in his address to the federal oil conservation board, May 27, 1926, said:[24]

It has already been pointed out to the board that the legislatures of oil-producing states have enacted various laws of a regulatory sort intended to prevent waste. It would not be safe, however, to infer that laws which were not appropriately designed to prevent improper methods in extracting the oil, or to protect the interest of proprietors drawing from a common reservoir so that the action of one should not work a deprivation of the rights of others, but were directed to the prevention of curtailment of production itself, would be sustained in the absence of compensation to the owner who was thus deprived of the use of his property. Still less can it be assumed that a state would have the power to compel an owner to subject his right to drill for oil on his property, not to regulations to prevent waste or for the purpose of preventing injury to other owners having a similar right, but, as has been suggested by some, to the will of the other owners as to whether or not drilling should take place; that is, to make the exercise of the owner's right dependent upon the wishes of other individuals not vested with governmental authority.

24. Federal Oil Conservation Board Hearings, May 27, 1926, p. 21.

As far as existing conservation statutes are concerned it is not likely that any statute prohibiting an operator from engaging in practices which would injure an oil and gas formation would be constitutional. It is not likely, either, that a statute designed to prevent the escape of gas into the air resulting in its dissipation would be constitutional. When questions arise involving the waste of oil discriminating questions of constitutionality arise. The courts have generally followed the Ohio Oil Company vs. Indiana on questions affecting oil rights.

The conservation law of the state of Oklahoma has a section[25] that provides that the taking of crude oil from any sand in the state at a time when there is not a market demand for it at the well at a price equivalent to the actual value of the oil is prohibited, and the actual value of the crude oil shall be the average value as nearly as may be ascertained at retail of the by-products when refined less the cost and a reasonable profit in the business of transporting, refining and marketing of it. The corporation commission is "invested" with the authority and power to investigate and determine from time to time the actual value of crude oil according to the above standards. When these values are determined the commission shall make an order to that effect and publish it in some newspaper of general circulation. This law has never been enforced because unquestionably it is a price fixing statute and for that reason unconstitutional.

There is no statute on the books of any state that clearly meets the problem of stabilization. Probably the nearest to this ideal is the Lyon gas conservation law of California. As was mentioned in a previous chapter this law was approved by the superior court in Los Angeles but it has not yet been tested out by the supreme court of that state.

Another way by which a portion of the industry has sought relief from the federal government for the evil effects of overproduction was a petition to congress to provide a dollar a barrel tariff on crude petroleum imports. This petition was initiated by the Independent Petroleum Association of America. After a bitter debate in the senate the clause providing for a tariff on petroleum was defeated. The leaders of the Independent Petroleum Association are still active in their efforts to secure a tariff on petroleum. It is unlikely, however, that they will be successful during this administration and with the present congress.

The issues affecting the relationship between the petroleum industry and the government are not yet settled. In spite of the legal obstacles in the way the relations are improving every day. Each is attempting more and more to co-

25. *Compiled Oklahoma Statutes*, 1921, Vol. II, Sec. 7955.

operate in the solution of a common problem, a problem that affects both the public and private interests. Using the words of Merle Thorpe:[26]

If partnership of government and business bears fruit—and it will—the history of America written a century hence will devote one chapter to the new era. But if business fails to meet the test of responsibility, or if government leaders fail to meet the test of working with business then the experiment will be accorded only a footnote in small type on that history's page.

26. Merle Thorpe, "Partners for Prosperity," *Nation's Business,* January, 1930, p. 9.

CHAPTER ELEVEN

THE PROBLEM

INDIVIDUALS in any industry are inclined to look at their business as they do their other personal affairs and feel that only they have burdens to bear. The petroleum industry is not different from any other industry because it has a problem. Each industry has a problem, or problems, that it must solve. The petroleum industry does have a problem, however, that is different from the problems of other industries.

The preceding chapters are an attempt to analyze the economic forces as they apply to the petroleum industry in making it a going concern and to point out the limiting factors. It was shown in Chapter II that the trend of the industry was toward integration, centering around the Standard Oil Company. This trend continued until 1911 when the supreme court of the United States dissolved it into thirty-three separate and independent units. This period was marked by the concentration and control of the refining and marketing branches of the industry. The production side was maintained on an individualistic basis and in this branch competition was encouraged. Although periods of overproduction frequently occurred there was a growing demand for petroleum and its products. Attempts by the operators were made unsuccessfully to curtail production from time to time. Since the manufacturing and marketing branches were highly integrated it was to their interest to stimulate individual initiative in the production of oil. Cheap crude made possible their rapid development.

It was during this period, 1859-1911, that the feudal law of oil and gas was formulated. It was in this period that the courts formulated the analogy of petroleum to wild animals and, also, said:[1]

> As we understand it, every landowner or his lessee may locate his wells wherever he pleases, regardless of the interests of others. He may distribute them over the whole farm or locate them only on one part of it. He may crowd the adjoining farms so as to enable him to draw the oil and gas from them. What then can the neighbor do? Nothing; only go and do likewise. He must protect his own oil and gas. He knows it is wild and will run away if it finds an opening and it is his business to keep it at home.

When the Standard Oil Company was being dissolved in 1911 a new development was rapidly taking place in the industry. It was at this time that the industry was changing from a kerosene basis to a gasoline basis. The breaking up of the old Standard Oil Company came at the most appropriate time as far as it was concerned. The development of the automotive industry placed new demands on the petroleum industry. Although

1. See Chapter IV, p. 46.

competition was keen and individualism reigned supreme, the growing demand for gasoline brought about a tremendous growth of the various units and there was room enough for all to survive. During this period production continued, as before, to remain on an individualistic basis. The law that was formulated in the previous period governing production was not unsuited for this era. It was during this second phase of the development of the industry that the Mid-Continent area began to assume the rank of a major field. New fields were discovered and the horizon of production was extended.

The outbreak of the European war in 1914 stimulated the demand for petroleum and its products. The entry of the United States in 1917 further stimulated the demand and suddenly brought about a realization at home of a possible famine. This realization caused refining and marketing companies to go into the producing end of the business in order to insure an adequate supply. The entry of the companies engaged in marketing and refining brought to the producing industry an improved technique. Production engineering was stimulated. The possibility of famine directed the attention of the industry and the public to physical and economic waste in the production of petroleum. The main emphasis, however, was placed upon physical waste.

The entry of the refining and marketing companies into the production branch of the industry brought about a new alignment among the producers. On one side were the producers affiliated with the refining companies, on the other were the independent producing companies. As long as the refining companies were not directly interested in the production branch of the industry they were willing, if not indifferent, for competitive conditions in the production of oil to remain. After their entry into the producing business their attitude changed. Under the old law formulated during the previous period they were enabled to secure a sufficient reserve of crude oil. The technique of production such as the air-lift, rotary drill, and other engineering devices, and the development of the science of geology, including the use of paleontology and geophysical instruments, served to bring about a period of chronic overproduction beginning with 1921 and continuing to date.

It is at this point the petroleum industry has a problem that is different to those of other industries. All of its economic troubles today may not be the result of overproduction of crude oil, but if they are not, they had their origin there. The problem of supply in the petroleum industry is peculiar to it alone. There is no other primary industry where the producer is forced to continue production regardless of unfavorable economic conditions. The farmer may leave his land idle. The mining companies may close their mines. Of course, the fixed costs will continue, but the miner may save his operating

costs and that is more than the petroleum producer may do. The lumber companies may leave the trees in the forest and fishermen may remain on shore but the petroleum producer must continue his operations because oil pools are common reservoirs, and the oil and gas, not being fixed in place, can be drained from under the various properties through wells drilled on adjoining properties. Each owner in a pool must drill if others drill or lose his part of the oil and gas. These are facts familiar to those in the industry and to those who live in the oil regions but facts that might be overlooked by others. It is this condition of chronic overproduction, subject to the peculiarities of the petroleum industry, that is the limiting factor today.

It was pointed out in Chapters VIII an IX that to overcome this condition it would be necessary to make the pool the unit of operations instead of the lease. Today the lease is the basic contract of the industry. It may remain the basic contract but not the unit of operations. It was the purpose of Chapter X to show that the fundamental law of the land must be changed in order to permit the pool to be made the unit of operations.

President Coolidge, in 1924, appointed the federal oil conservation board, consisting of four members of the cabinet, including the secretary of the interior, the secretary of war, the secretary of the navy, and the secretary of commerce. This board has issued three reports and has accumulated a vast amount of information on the industry, but has accomplished little else. No important legislation has been passed by congress or any of the states affecting unit operation or requiring the pool to be operated as a unit, except recent amendments by congress to sections 17 and 27 of the general leasing act of 1920, which permits participation in unit operation agreements by both the government and authorized lessees of government land. The only real good, so far, that has come out of the work of the federal oil conservation board has been the education of all the members of the industry and the general public to the needs of the industry and the extent that the public welfare is tied up with it.

This stimulation of interest in the problems of the petroleum industry, generated by the federal oil conservation board, has assumed two different viewpoints by the industry and by the public, respectively. However, they have a community of interest. The industry is primarily interested in stabilization. The public is primarily interested in conservation. The petroleum resources are dwindling resources. If conservation means taking thought of the morrow then the two interested groups have something in common. Conservation and stabilization are not synonymous terms. Yet, as it happens now, they may have a common aim. It is not implied here that the members of the industry are not interested in conservation on its own merits, neither is it implied that all of them are. Also, it may be said that all laymen

who are interested in conservation of the petroleum resources have not been particularly interested in the stabilization of the industry. The interest that the government has taken thus far in the problem has been mainly in the conservation of a perishable resource. It is to the interest of all parties concerned, irrespective of their goal, to co-operate for they have more in common than not. Conservation and stabilization may be achieved through the co-operation of the government, the industry, and the public. Without co-operation neither may be gained.

The obstacles in the way in arriving at an early adoption of a conservation and stabilization program are:[2]

1. The investment of new capital in the industry since the world war that requires dividends from flush production.
2. The entrance of new people into the industry that had never been in it before.
3. Individualism.
4. Promoters who seek new fields to sell out at a profit.
5. Small refiners who do not have a certain supply of crude oil.
6. Distrust of the small independent operator and a few large independent operators for the large integrated oil companies.
7. Opposition of royalty owners.
8. The oil lawyer, who for the benefit of his client, applies or appeals to present laws.

If the petroleum industry continues its present trend it is evident that the fundamental law of the land, now at variance with economic needs and sound engineering practice will have to be changed or modified; and oil pools will be operated as units.[3] If conditions become worse the obstacles listed above will be forced to give way through the force of public opinion and economic pressure. While this change is taking place it is likely the more competitive pools will become depleted more quickly. Experience has proved, as was cited in a previous chapter, that competitive pools are exhausted more readily than those pools operated under co-operative agreements. As the competitive pools become exhausted the non-competitive pools will become more and more under the control of the integrated companies. When this takes place the influence of the independent operators will be considerably diminished. Before the independent operator is eliminated he will realize it is to his best interest to enter into co-operative agreements. Using the language of a Negro and frequently quoted in the oil region: "If yo cain't whip 'em, jine 'em."

Many independent operators today wholeheartedly support the proposed unit operation programs. There are some large ones and many more small ones

2. James A. Veasey, "May the American Petroleum Industry, Through Voluntary Action, Meet Its Problems of Overproduction," *Mining and Metallurgy,* April, 1929, p. 190.
3. Joseph E. Pogue, "Economic Trend of the Oil Situation," *National Petroleum News,* October 9, 1929, p. 48-J.

who do not. The chief source of opposition to co-operative development programs is the royalty owners and the lease and royalty brokers. It is the combination of all the obstacles rather than any one that prevents an early adoption of co-operative agreements in petroleum production.

There have been other remedies suggested as to how the petroleum industry could bring about stabilization. Not all of them are worthy of mention. Two of them are worth consideration. It has been suggested from time to time that the industry find new uses for its products. This is not in the interest of conservation or stabilization. New uses would give temporary relief and would serve to take off the market the surplus product. It is not wise to increase society's habits of consumption when the supply of the good is as uncertain as that of petroleum today. There are extreme optimists who think the supply will never become exhausted. There are others who think there will be ample petroleum for several years and in the meantime an adequate substitute will be found. There are others who are pessimistic. It is true the known petroleum resources are adequate to meet the normal needs of society for several years to come at the normal rate of increase in demand. The Oklahoma City field, Kettleman Hills in California, and Pecos county, Texas, are three flush fields with abundant resources. The settled fields will produce for years to come. The stimulation of demand with new uses, however, can bring them to a rapid depletion. Let five or ten years elapse before another field as large as the smallest of these is discovered, or even in less time, the price will be so high that its marginal utility will be contracted to the most essential uses. Instead of increasing the uses they should be decreased in the interests of conservation. It is not intended here to suggest the denial of the present enjoyments in the consumption of petroleum products. It does mean that a more economical and efficient use can be made than there is being made today.

Another suggestion[4] is to run all crude oil to government account or to "a bureau similar to the new federal farm board or the federal reserve bank board" and let refiners buy their crude oil supplies from that agency. This plan would serve only to aggravate the problem. This plan would not limit production. Any governmental agency that may be appointed to handle the reserve would have no more power to control production than the refiners have now. It would mean that the producers would be subsidized by public funds. If the price were cut production would continue for the reason given above. Since the lease is the unit of operation instead of the pool the operator must continue to save his oil even though he may be operating at a loss. If the operator were required to co-operate through a unit operation program

4. *National Petroleum News,* December 25, 1929, p. 30.

then there would be no need for a petroleum relief board. The plan would take care of the situation without the help of the board.

Now curtailment programs are applied mainly in fields with flush production. If a permanent policy is to be pursued it should extend to secondary fields as well as to those with flush production. Wildcat areas, too, should be curbed. There is another factor that has not received the proper attention, i.e., the influence of refining operations on production. The annual increase in refinery capacity is estimated to be eight per cent. But let it be six, ten or twelve per cent, it makes no difference as far as our problem is concerned. Whatever the per cent increase may be, if all refiners agree to limit their annual expansion to that amount it would be a contributing factor to stabilization. If, however, a refiner thinks that he is entitled to more business and should increase his plant twenty per cent, fifty per cent or a hundred per cent, he not only encourages overproduction but he demoralizes the market for refined products. More filling stations must be built to furnish an outlet and most any zoning commission will testify there are too many filling stations now. This act stimulates his competitors to go and do likewise and so the process is started all over again.

The increase in the number of motor driven vehicles, the building of roads, the closed car, the clearing of roads from snow in the northern states, the building of suburban homes, and the increase in the habit of driving automobiles has greatly increased the demand for gasoline during the last fifteen years. This increase in gasoline consumption has made possible the rapid expansion of service station facilities. If these stations do not reach an economic saturation point soon they will reach a physical saturation point. The fact that the marketers are now competing for "gallonage" is an indication that the saturation point is about reached.

The supply of crude oil is uncertain. Refiners, for this reason, have always attempted to maintain as large a reserve of crude oil as possible. They have kept large quantities in storage. This policy has encouraged overproduction. The surplus is run into storage creating large stocks and these in turn have had a depressing influence on crude oil prices.

Two more suggestions are ventured in the interest of conservation with reference to prolonging the life of "strippers" and marginal wells. The terms of the lease contract should be drawn providing for a sliding royalty scale. The customary royalty payment on commercial leases is one-eighth. When a well is about exhausted and the price is low it becomes unprofitable to continue to operate the well. In some instances in Oklahoma where operators have had wells under these conditions they have turned them over to the royalty owners at the price the equipment would sell for junk. If a

lease contract would be drawn which would provide for an adjustment between the operators and the royalty owners, whether operated under a unit plan or not, when the price fell below the cost of production so that the operator could carry on production it would result in a benefit to both. Especially if this kind of agreement is made where the operations are carried on under a unit plan more production may be recovered than would otherwise and would result in the long run in a greater net return to all persons concerned. When prices went back up the royalties would increase to their former percentage.

The other suggestion relates to the gross production tax. Most oil producing states have a gross production tax. The gross production tax in Oklahoma is three per cent, and is the chief source of revenue to the state. According to the criteria of good taxes this tax is fifty per cent a failure. The criteria referred to are uniformity, certainty, convenience, simplicity, economy, and justice. This tax can only conform to about three of these. These are convenience, certainty, and simplicity. As far as convenience is concerned it is very inconvenient when applied to marginal wells. No tax can be said to be convenient from the taxpayer's viewpoint but the marginal operator is sometimes forced to pay a tax when operating at a loss. It is simple because it is easily understood and easily administered when compared to other forms of taxation. The tax is certain but state revenues suffer as do the operators when the price of crude oil is low.

The tax is not uniform because a three per cent gross production tax would fall more heavily on the small well. This three per cent tax in a period of low prices would mean the choice to the operator of closing down or continuing operations at a loss. Uniformity of taxation means the placing of the burden equally upon the base. Wells with large flush production are more able to bear a heavier tax while the wells with small settled production should in the interests of conservation carry a lighter tax than the large flush production wells.

It is not economical in the sense that it works against conservation rather than for it because the three per cent tax bears unduly on the marginal wells. By lightening the tax on marginal wells it would permit the recovery of more oil than is now economically possible. There is no justice in a tax when it bears more heavily on some than it does on others. The problem is not whether a large company with more production should pay a higher rate than a small company. As often as not the larger companies are operating marginal wells. The distinction should be made between wells and not individuals. To be more scientific, the tax should be on a sliding scale based not on the production of a well but on the production of the acre. The productivity of an oil pool is not measured by the barrels to the well but by the bar-

rels to the acre. Pools with a larger production the acre should bear a heavier gross production tax than pools with a smaller production to an acre. As to what the sliding scale should be is an engineering problem. Costs of drilling operations should be taken into consideration. After the operator has been reimbursed for his actual well costs, not including cost of lease, then apply a sliding scale as worked out by engineers, to all oil over and above these costs.

It was stated in the introductory chapter that the problem of stabilization was a two-fold one; that it involved both engineering and economics. Like most other pressing, modern economic problems a consideration of these two involves a theory of value. Stabilization involves the stabilization of prices or the stabilization of output. Price is a scarcity value, output is a use value. Economic value is the functional relationship of scarcity value and use value. Therefore, stabilization means the maintenance of economic values. The stabilization of the petroleum industry means the maintenance of economic value as it relates to the product of the industry. Economics is primarily concerned with scarcity values. Engineering is primarily concerned with the production of use values. Since stabilization involves the stabilization of prices and the stabilization of output, use values; the problem is, which of the two variables should be stabilized? Should prices control output, or should output control prices? The answer to this question may not apply equally to all industries. When applied to the petroleum industry, the answer is, output should control prices. It was pointed out above that the petroleum industry has one peculiarity. The producer must continue operations whether economic conditions are favorable or unfavorable. If an attempt were made to make prices control output it would fail because the producer must continue to produce oil and gas lest his neighbor take them from him. If prices were controlled and made low it would not help the producer. If they were raised so that the producer could operate at a profit there would be an inducement for other operators to enter the business and the plan of conservation, since this is an exhaustible resource, would be defeated. The only alternative, then, is to control output.

If output is to be controlled, the next question is, should the control be voluntary or involuntary? Voluntary control is preferable. It is unconstitutional to compel property owners to combine their properties because it would be a restriction of liberty. The only way involuntary control may be brought about would be through the police power of the state to conserve a natural resource. It has been suggested that the federal government would have the power to compel involuntary control through its power to provide for the common defense. If the federal government were in a state of war it is not

denied that it would have the power. It is a debatable question if it has such power in time of peace. Involuntary control is offensive to American ideals, repugnant to American institutions and repulsive to the individuals affected.

How may voluntary control be achieved? The first thing to do is remove restrictive legislation. However, in the removal of restrictive legislation supervision must be maintained by the government to prevent any combinations in unreasonable restraint of trade. After these restrictions are removed a campaign of education by the government and by the industry should be carried on to show why this control is necessary. There will be a few recalcitrant individuals who will refuse to enter into voluntary agreements. There never was a program of any kind, to which someone failed to object. These refractory individuals, however, will not stop the progress of the plan because the weight of opinion is already on its side. Not only is the weight of opinion on its side but the weight of the strongest operators. As the educational campaign progresses the minority will grow smaller.

The goal of the classical economist was a state of equilibrium. The goal of the modern economist is stabilization. The problem of stabilization is to secure control of the limiting factor. The limiting factor in the petroleum industry is overproduction. The most practical method to control overproduction is through voluntary co-operation and control with the pool, instead of the lease, as the unit of production.

APPENDIX

APPENDIX

*TABLE I**

United States Crude Oil Production and Value of Oil

Year	*Total Wells Completed*	*Production (Thousands of Barrels*	*Value at Wells (000 omitted)*
1859	2	2	$ 32
1860	49	500	4,800
1861	78	2,114	1,036
1862	92	3,057	3,210
1863	137	2,611	8,226
1864	226	2,116	20,897
1865	474	2,498	16,460
1866	442	3,598	13,455
1867	618	3,347	8,067
1868	928	3,646	13,217
1869	1,500	4,215	23,730
1870	1,664	5,261	20,504
1871	1,470	5,205	22,591
1872	1,183	6,293	21,441
1873	1,263	9,894	18,100
1874	1,317	10,927	12,648
1875	2,400	8,788	7,368
1876	2,920	9,133	22,983
1877	3,940	13,350	31,789
1878	3,064	15,397	18,045
1879	3,049	19,914	17,211
1880	4,220	26,286	24,601
1881	3,833	27,661	23,512
1882	3,307	30,350	23,631
1883	2,850	23,450	25,740
1884	2,269	24,218	20,477
1885	2,814	21,859	19,194
1886	3,583	28,065	20,028
1887	1,981	28,283	18,857
1888	2,127	27,612	17,950
1889	6,507	35,164	26,963
1890	8,347	45,824	35,365
1891	5,101	54,293	30,527
1892	3,771	50,515	25,950
1893	4,170	48,431	28,932
1894	7,551	49,344	49,344
1895	13,069	52,892	52,892
1896	13,808	60,960	60,960
1897	9,538	60,476	60,476
1898	8,644	55,364	55,364
1899	13,984	57,071	57,071
1900	15,517	63,621	63,621
1901	14,372	69,389	64,417
1902	15,407	88,767	71,179
1903	18,365	100,461	94,694
1904	20,261	117,081	101,175
1905	16,731	134,717	84,157
1906	19,057	126,494	92,445
1907	19,872	166,095	120,107
1908	16,909	178,527	129,079
1909	18,327	183,171	128,328
1910	14,940	209,557	127,900
1911	13,768	220,449	134,045

TABLE I (Continued)

1912	17,180	222,935	164,212
1913	25,590	248,446	237,121
1914	23,137	265,763	214,125
1915	14,157	281,104	179,463
1916	24,619	300,767	330,900
1917	23,407	335,316	522,635
1918	25,687	355,928	703,944
1919	29,173	378,367	760,266
1920	33,911	442,929	1,360,745
1921	21,937	472,183	814,745
1922	24,689	557,531	895,111
1923	24,438	732,407	978,430
1924	21,888	713,940	1,022,683
1925	25,623	763,745	1,284,960
1926	29,319	770,874	1,447,760
1927	24,143	901,129	1,172,830
1928	22,331	900,364	1,080,437

*Adapted from data from Bureau of Mines.

TABLE II

Production, Consumption, and Stocks of Crude Petroleum in the United States, By Months, 1920-1929*

	Production of Crude Oil in United States 1920-1929. (000 Omitted)	*Consumption of Crude Oil in United States 1920-1929. (000 Omitted)*	*Stocks of Crude Oil in United States 1920-1929 (000 Omitted)*	*Price of 33° Mid-Continent Crude 1920-1929*	*Wells Drilled*
1920					
Jan.	34,008	40,876	131,099	$2.96	
Feb.	33,193	38,293	130,099	3.026	
Mar	36,171	42,804	129,108	3.50	
Apr.	34,945	40,954	128,618	3.50	
May	36,622	42,949	128,526	3.50	
June	36,663	41,481	131,299	3.50	
July	37,746	42,935	132,112	3.50	
Aug.	38,906	47,040	134,272	3.50	
Sept.	37,521	48,367	134,360	3.50	
Oct.	39.584	48,307	136,285	3.50	
Nov.	38,609	48,691	139,234	3.50	
Dec.	38,961	47,835	142,422	3.50	
1921					
Jan.	38,138	49,534	125,589	3.355	
Feb.	35,524	39,362	132,222	1.875	
Mar.	41,105	45,248	139,499	1.75	
Apr.	40,233	42,562	146,399	1.75	
May	42,189	41,463	155,267	1.508	
June	40,548	42,893	162,463	1.217	
July	40,461	41,479	168,821	1.00	
Aug.	41,109	42,583	169,682	1.00	
Sept.	36,763	41,702	172,874	1.00	
Oct.	35,832	45,314	174,149	1.452	
Nov.	38,108	45,987	178,260	1.90	
Dec.	42,173	47,905	185,623	2.00	

TABLE II (Continued)

1922					
Jan.	43,690	45,192	196,228	2.00	1,657
Feb.	41,314	39,933	208,851	2.00	1,631
Mar.	47,188	47,369	221,588	2.00	1,802
Apr.	45,167	41,258	235,962	2.00	1,991
May	47,002	48,838	247,093	2.00	2,054
June	46,087	48,449	255,817	2.00	2,219
July	47,134	50,877	261,395	1.75	2,430
Aug.	47,059	54,983	262,707	1.258	2,469
Sept.	45,805	48,166	263,761	1.25	2,304
Oct.	48,410	56,159	265,073	1.25	2,053
Nov.	48,027	54,363	265,017	1.25	2,192
Dec.	50,642	56,845	264,578	1.25	1,887
1923					
Jan.	52,527	58,120	258,197	1.376	1,956
Feb.	48,588	53,293	260,717	1.757	1,713
Mar.	56,969	56,676	264,899	1.85	1,889
Apr.	59,008	58,530	270,155	1.823	2,237
May	62,377	57,643	279,272	1.502	2,618
June	62,845	54,938	290,252	1.45	2,583
July	65,925	60,194	299,368	1.45	2,545
Aug.	66,422	63,918	307,100	1.45	2,290
Sept.	65,306	63,742	314,493	1.39	1,887
Oct.	67,506	62,684	323,789	1.30	1,700
Nov.	15,388	61,517	332,887	1.07	1,561
Dec.	59,546	63,607	334,774	1.00	1,459
1924					
Jan.	57,273	51,013	375,415	1.248	1,263
Feb.	55,889	49,907	378,774	1.593	1,422
Mar.	60,141	52,699	382,220	1.716	1,655
Apr.	59,830	53,114	387,998	1.75	2,060
May	61,834	54,725	393,141	1.75	2,384
June	59,583	52,436	397,039	1.75	2,169
July	61,932	52,876	401,344	1.718	2,237
Aug.	62,398	54,643	407,797	1.50	2,021
Sept.	60,376	53,617	411,524	1.363	1,693
Oct.	60,469	55,779	409,030	1.10	1,638
Nov.	56,782	55,029	406,450	1.10	1,661
Dec.	57,433	57,881	399,792	1.10	1,685
1925					
Jan.	60,400	57,480	419,364	1.194	1,425
Feb.	54,775	53,121	420,311	1.702	1,596
Mar.	61,339	59,552	420,636	1.80	1,768
Apr.	62,048	59,310	423,656	1.80	2,365
May	68,850	62,379	430,075	1.80	2,453
June	67,240	64,913	431,067	1.80	2,471
July	67,763	67,575	431,938	1.80	2,638
Aug.	67,580	67,016	431,202	1.76	2,488
Sept.	65,432	62,115	433,408	1.55	2,277
Oct.	64,842	63,970	433,342	1.55	2,288
Nov.	61,927	60,310	433,468	1.55	2,020
Dec.	61,547	62,179	428,803	1.55	1,894
1926					
Jan.	59,981	61,103	429,858	1.55	1,963
Feb.	54,892	56,347	427,823	1.80	1,807
Mar.	60,880	62,743	427,781	1.80	2,124
Apr.	60,371	61,531	417,715	1.80	2,226
May	62,822	65,354	416,436	1.94	2,383
June	61,789	64,810	410,623	2.05	2,547
July	65,168	67,335	406,909	2.05	2,943
Aug.	67,009	67,589	404,336	2.05	2,804
Sept.	65,782	66,420	402,155	2.05	2,579

TABLE II (Continued)

Oct.	69,664	68,907	401,546	2.05	2,854
Nov.	69,891	67,641	400,684	1.91	2,674
Dec.	72,625	69,484	403,338	1.75	2,415
1927					
Jan.	71,758	69,528	405,296	1.75	2,158
Feb.	68,122	62,961	410,837	1.70	2,009
Mar.	75,514	68,672	397,814	1.30	2,128
Apr.	73,132	66,493	423,856	1.22	2,411
May	76,845	69,700	431,590	1.22	2,066
June	75,303	67,567	440,438	1.22	1,985
July	78,780	71,405	448,919	1.22	2,143
Aug.	78,788	70,957	456,501	1.22	1,888
Sept.	75,909	68,532	462,931	1.22	1,889
Oct.	77,534	71,761	466,839	1.22	1,857
Nov.	74,493	69,988	472,896	1.22	1,995
Dec.	74,951	71,271	473,379	1.22	1,614
1928					
Jan.	72,793	69,161	474,262	1.22	1,421
Feb.	68,565	66,648	478,829	1.21	1,589
Mar.	74,528	72,621	483,534	1.19	1,723
Apr.	72,393	73,084	485,218	1.19	1,826
May	75,277	77,414	485,358	1.19	1,771
June	72,676	75,958	484,906	1.19	1,916
July	75,584	80,602	483,352	1.19	1,895
Aug.	77,807	81,581	482,074	1.21	2,082
Sept.	76,484	79,894	480,153	1.21	2,053
Oct.	79,751	79,663	481,658	1.21	2,085
Nov.	76,123	77,149	481,585	1.21	2,066
Dec.	79,493	79,520	484,267	1.21	1,904
1929					
Jan.	81,979	78,825	492,014	1.19	1,859
Feb.	75,693	72,031	499,897	1.11	1,833
Mar.	82,515	80,708	506,081	1.11	1,878
Apr.	80,110	80,459	509,608	1.11	2,163
May	84,415	84,420	512,212	1.18	2,096
June	83,403	84,400	515,990	1.30	2,159
July	91,327	85,919	523,613	1.30	2,411
Aug.	92,288	86,733	532,975	1.30	2,662
Sept.	87,269	84,099	537,421	1.30	2,355
Oct.	88,099	88,390	538,313	1.30	2,515
Nov.	78,161	81,061	533,337	1.30	2,450
Dec.	80,339	80,663	534,526	1.30	1,975

*Figures for consumption, production, and stocks and well data were compiled from reports of the United States bureau of mines. The price data for the months of January, 1920, through June, 1927 were taken from the report of the federal trade commission, *Petroleum Industry—Prices, Profits and Competition, 1929,* pp. 318-319. Prices for July, 1927 through December, 1929 were compiled from *The Oil and Gas Journal.*

TABLE III

Wells Drilled in the United States 1922-1929, by months, and the American Telephone and Telegraph Company Business Curve

Dates	*Wells Drilled*	*A. T. & T. Business Curve*
1922		
Jan.	1,657	−20
Feb.	1,631	−17
Mar.	1,802	−13
April	1,991	−18
May	2,054	−14
June	2,219	− 8
July	2,430	− 6
Aug.	2,469	−10
Sept.	2,304	− 5
Oct.	2,053	− 1
Nov.	2,192	+ 4
Dec.	1,887	+ 7
1923		
Jan.	1,956	+ 7
Feb.	1,713	+ 6
Mar.	1,889	+11
April	2,237	+15
May	2,618	+15
June	2,583	+14
July	2,545	+13
Aug.	2,290	+ 9
Sept.	1,887	+ 6
Oct.	1,700	+ 3
Nov.	1,561	+ 1
Dec.	1,459	− 2
1924		
Jan.	1,263	+ 1
Feb.	1,422	+ 4
Mar.	1,655	+ 2
April	2,060	− 3
May	2,384	− 9
June	2,169	−14
July	2,237	−15
Aug.	2,021	−11
Sept.	1,693	− 7
Oct.	1,638	− 3
Nov.	1,661	− 2
Dec.	1,685	+ 2
1925		
Jan.	1,425	+ 5
Feb.	1,596	+ 5
Mar.	1,768	+ 3
April	2,365	+ 3
May	2,453	+ 2
June	2,471	+ 2
July	2,638	+ 3
Aug.	2,488	+ 4
Sept.	2,277	+ 2
Oct.	2,288	+ 4
Nov.	2,020	+ 6
Dec.	1,894	+ 6
1926		
Jan.	1,963	+ 5
Feb.	1,807	+ 4
Mar.	2,124	+ 4

TABLE III (Continued)

April	2,226	+ 4
May	2,383	+ 4
June	2,547	+ 6
July	2,943	+ 6
Aug.	2,804	+ 7
Sept.	2,579	+ 9
Oct.	2,854	+ 9
Nov.	2,674	+ 7
Dec.	2,415	+ 7
1927		
Jan.	2,158	+ 5
Feb.	2,009	+ 6
Mar.	2,128	+ 8
April	2,411	+ 5
May	2,066	+ 6
June	1,985	+ 7
July	2,143	+ 6
Aug.	1,888	+ 5
Sept.	1,889	+ 3
Oct.	1,857	+ 0
Nov.	1,995	— 3
Dec.	1,614	— 5
1928		
Jan.	1,421	— 3
Feb.	1,589	— 2
Mar.	1,723	— 1
April	1,826	+ 0
May	1,771	+ 1
June	1,916	+ 1
July	1,895	+ 4
Aug.	2,082	+ 4
Sept.	2,053	+ 5
Oct.	2,085	+ 6
Nov.	2,066	+ 5
Dec.	1,904	+ 3
1929		
Jan.	1,859	+ 4.0
Feb.	1,833	+ 5.0
Mar.	1,878	+ 4.2
April	2,163	+ 7.4
May	2,096	+ 9.4
June	2,159	+11.5
July	2,411	+ 9.9
Aug.	2,662	+ 9.0
Sept.	2,355	+ 7.4
Oct.	2,515	+ 3.9
Nov.	2,450	— 4.0
Dec.	1,975	— 8.4

*TABLE IV**

Monthly Average Index of Mid-Continent Petroleum and Wholesale Prices 1921-1929

Date	*Index Petroleum Prices*	*Index Wholesale Prices*
1921		
Jan.	176.8	114.8
Feb.	98.9	105.7
Mar.	92.1	103.1
April	92.1	99.6
May	79.4	96.9
June	64.2	94.1
July	52.6	94.1
Aug.	52.6	94.2
Sept.	52.6	94.2
Oct.	76.3	94.9
Nov.	100.0	95.0
Dec.	105.2	93.7
1922		
Jan.	105.2	92.2
Feb.	105.2	93.7
Mar.	105.2	93.6
April	105.2	94.0
May	105.2	97.0
June	105.2	97.2
July	92.1	100.3
Aug.	66.3	99.6
Sept.	65.7	100.3
Oct.	65.7	100.6
Nov.	65.7	101.5
Dec.	65.7	101.7
1923		
Jan.	72.6	103.1
Feb.	92.6	104.4
Mar.	97.3	105.6
April	95.7	105.0
May	78.9	103.0
June	76.3	101.4
July	76.3	99.5
Aug.	76.3	98.9
Sept.	73.1	100.9
Oct.	68.4	100.6
Nov.	56.3	99.6
Dec.	52.6	99.3
1924		
Jan.	65.7	100.8
Feb.	84.2	100.9
Mar.	90.5	99.7
April	92.1	98.5
May	92.1	97.1
June	92.1	96.1
July	90.5	96.8
Aug.	78.9	98.3
Sept.	71.5	98.4
Oct.	57.8	99.5
Nov.	57.8	100.4
Dec.	57.8	102.9
1925		
Jan.	63.1	104.3
Feb.	89.4	105.5
Mar.	94.7	105.7
April	94.7	103.3
May	94.7	103.1

TABLE IV (Continued)

June	94.7	104.5
July	94.7	105.8
Aug.	92.6	105.4
Sept.	81.5	105.0
Oct.	81.5	105.2
Nov.	81.5	106.1
Dec.	81.5	105.0
1926		
Jan.	81.5	105.2
Feb.	94.7	103.7
Mar.	94.7	102.0
April	94.7	101.7
May	102.1	102.1
June	107.8	102.1
July	107.8	101.1
Aug.	107.8	100.6
Sept.	107.8	101.4
Oct.	107.8	101.1
Nov.	100.5	100.1
Dec.	92.1	99.6
1927		
Jan.	92.1	98.3
Feb.	89.4	97.6
Mar.	68.4	96.2
April	64.2	95.4
May	64.2	95.4
June	64.2	95.5
July	64.2	95.8
Aug.	64.2	96.9
Sept.	64.2	98.3
Oct.	64.2	98.8
Nov.	64.2	98.5
Dec.	64.2	100.5
1928		
Jan.	64.2	98.1
Feb.	63.6	98.3
Mar.	62.6	97.9
April	62.6	99.3
May	62.6	100.5
June	62.6	99.5
July	62.6	100.3
Aug.	63.6	100.9
Sept.	63.6	102.1
Oct.	63.6	99.8
Nov.	63.6	98.7
Dec.	63.6	98.7
1929		
Jan.	62.6	99.2
Feb.	58.4	98.7
Mar.	58.4	99.6
April	58.4	98.9
May	62.1	97.8
June	68.4	98.5
July	68.4	100.1
Aug.	68.4	99.8
Sept.	68.4	99.6
Oct.	68.4	98.4
Nov.	68.4	96.5
Dec.	68.4	96.3

*Index of Mid-Continent 33°-33.9° gravity crude, posted prices, Prairie Oil and Gas Company, *The Oil and Gas Journal*. Index of wholesale prices, United States bureau of labor.

TABLE IV—A

Crude oil prices, dollars per barrel of 42 gallons, Prairie Oil and Gas Company prices for 33-33.9 gravity, Oklahoma, Kansas and North Texas crude, 1927-1929. Data compiled from *The Oil and Gas Journal*. Figures in parentheses indicate dates of price changes.

1927					
Jan.	1.75	1.75	1.75	1.75	
				(22)	
Feb.	1.75	1.75	1.75	1.55	
			(12)		
Mar.	1.55	1.55	1.22	1.22	1.22
		(7)		(20)	
April	1.22	1.07	1.07	0.97	
May	1.07	1.07	1.07	1.07	1.07
June	1.07	1.07	1.07	1.07	
July	1.07	1.07	1.07	1.07	
Aug.	1.07	1.07	1.07	1.07	1.07
			(14)		
Sept.	1.07	1.07	1.22	1.22	
Oct.	1.22	1.22	1.22	1.22	
Nov.	1.22	1.22	1.22	1.22	1.22
Dec.	1.22	1.22	1.22	1.22	
1928					
Jan.	1.22	1.22	1.22	1.22	1.22
			(21)		
Feb.	1.22	1.22	1.19	1.19	
Mar.	1.19	1.19	1.19	1.19	
Apr.	1.19	1.19	1.19	1.19	
May	1.19	1.19	1.19	1.19	1.19
June	1.19	1.19	1.19	1.19	
					(26)
July	1.19	1.19	1.19	1.19	1.21
Aug.	1.21	1.21	1.21	1.21	
Sept.	1.21	1.21	1.21	1.21	
Oct.	1.21	1.21	1.21	1.21	1.21
Nov.	1.21	1.21	1.21	1.21	
Dec.	1.21	1.21	1.21	1.21	
1929					(25)
Jan.	1.21	1.21	1.21	1.21	1.11
Feb.	1.11	1.11	1.11	1.11	
Mar.	1.11	1.11	1.11	1.11	
April	1.11	1.11	1.11	1.11	1.11
			(20)		
May	1.11	1.11	1.30	1.30	
June	1.30	1.30	1.30	1.30	
July	1.30	1.30	1.30	1.30	1.30
Aug.	1.30	1.30	1.30	1.30	
Sept.	1.30	1.30	1.30	1.30	
Oct.	1.30	1.30	1.30	1.30	1.30
Nov.	1.30	1.30	1.30	1.30	
Dec.	1.30	1.30	1.30	1.30	1.30

Gasoline prices, cents per gallon, tank car, gravity 58-60, U. S. Motor specifications, Oklahoma group 3, 1927-1929, by months. Compiled from *The Oil and Gas Journal*. (Figures in parentheses indicate date of end of week.)

1927					
Jan.	(4)	(11)	(18)	(25)	
	.09	.09	.089	.9875	
Feb.	(1)	(8)	(15)	(22)	
	.0875	.0850	.0850	.08	
Mar.	(1)	(8)	(15)	(22)	(29)
	.0750	.0725	.0675	.0625½	.0560

TABLE IV—A (Continued)

April	(5) .0650	(12) .0625	(19) .0625	(26) .0625	
May	(3) .0625	(10) .0650	(17) .0650	(24) .0650	(31) .0650
June	(7) .066	(14) .066	(21) .066	(28) .0675	
July	(5) .066	(12) .066	(19) .066	(26) .066	.066
Aug.	(2) .066	(9) .0638	(16) .0638	(23) .0625	(30) .0625
Sept.	(6) .06	(13) .06	(20) .0612	(27) .0612	
Oct.	(4) .059	(11) .0575	(18) .0575	(25) .06	
Nov.	(1) .06	(8) .06	(15) .06	(22) .06	(29) .06
Dec.	(6) .06	(13) .059	(20) .0575	(27) .0575	
1928					
Jan.	(3) .0575	(10) .056	(17) .058	(24) .058	(31) .0575
Feb.	(7) .0575	(14) .0610	(21) .0621	(28) .0617	
Mar.	(6) .0618	(13) .0627	(20) .0642	(27) .0649	
April	(3) .0657	(10) .0663	(17) .0684	(24) .0685	
May	(1) .0694	(8) .0711	(15) .0730	(22) .0757	(29) .0755
June	(5) .0766	(12) .0783	(19) .0794	(26) .0792	
July	(3) .0795	(10) .0813	(17) .0841	(24) .0861	(31) .0901
Aug.	(7) .0947	(14) .0968	(21) .0971	(28) .0967	
Sept.	(4) .0976	(11) .0973	(18) .0975	(25) .0970	
Oct.	(2) .0973	(9) .0974	(16) .0975	(23) .0972	(30) .0957
Nov.	(6) .0957	(13) .0933	(20) .0932	(27) .0927	
Dec.	(4) .0913	(11) .0874	(18) .0871	(25) .0870	
1929					
Jan.	(1) .0833	(8) .0802	(15) .0800	(22) .0796	(29) .0775
Feb.	(5) .0702	(12) .0709	(19) .0707	(26) .0677	
Mar.	(5) .0702	(12) .0701	(19) .0702	(26) .0709	
April	(2) .0721	(9) .0738	(16) .0741	(23) .0752	(30) .0756
May	(7) .0763	(14) .0776	(21) .0788	(28) .0911	
June	(4) .0925	(11) .0924	(18) .0925	(25) .0925	
July	(2) .0923	(9) .0895	(16) .0853	(23) .0805	(30) .0798
Aug.	(6) .0735	(13) .0753	(20) .0778	(27) .0776	

Sept.	(3)	(10)	(17)	(24)	
	.0776	.0773	.0775	.0775	
Oct.	(1)	(8)	(15)	(22)	(29)
	.0771	.0773	.0775	.0773	.0761
Nov.	(5)	(12)	(19)	(26)	
	.0747	.0748	.0750	.0724	
Dec.	(3)	(10)	(17)	(24)	(31)
	.0722	.0725	.0725	.0725	.0685

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INDEX

INDEX

Acton vs. Blundell, 44
Advertising, 138
Allegheny fields, 107
Allotments, Indian, 61
Ambrose, A. W., 176, 177
American Bar Association, see Association
American Institute of Mining and Metallurgical Engineers, 80, 107, 129, 139 146, 149, 176
American Petroleum Institute, see Institute
American system, 43
American Telephone and Telegraph Company business curve, 225
American Telephone and Telegraph Company, 91
Angell, C. D., 57
Angier, J. D., 55
Anti-trust laws, 152, 197
Appendix, 219
Armstrong, David, 126
Arnold, Ralph, 106
Associated Press, 70, 105
Association
  American Bar, 150, 199
  American Association of Petroleum Geologists, 80, 106
  Independent Petroleum, 166, 206
  Independent Producers, 155
  Mid-Continent Oil and Gas, 57, 76, 80, 149, 156, 163, 166, 180, 187
  National Association of Independent Oil Producers, 116
  National Petroleum Marketers, 98, 142
  Petroleum Producers, 126
  Rocky Mountain Oil and Gas, 68
  Salt Creek Producers, 175
  Western Petroleum Refiners, 97
Atlantic Pipeline Company, 167
Bailey, Justice Jennings, 70
Ball, Max, 148
Barnard vs. Monongahela Natural Gas Company, 46
Bartlesville-Dewey District, 85, 86, 88
Barton, Roc C., 70
Bates, Henry M., 150
Beacon Oil Company, 21
Beaty, A. L., 135, 143, 144, 146, 172
Bedford, A. C., 135, 136
Beecher, C. E., 176, 177
Belvedere Gardens, 174
Biochemical decomposition, 38
Blackstone, 41
Board of Federal Oil Conservation, 83, 119, 143, 144, 145, 149, 150, 151, 155, 193, 199, 211
Bonuses, Indian lands, 61
Boundary line contract, 126
Bowditch, E. B., 56
Bowers, Colonel, 73
Boyle, Col. Patrick C., 56, 125
Bradford fields, 107
Breen, Frank M., 158
Brewer, Mr. Justice, 197
Brown, Walter F., 150
Bureau of Mines, 2, 80, 81, 105
Business cycles, 91
Bush, R. D., 82, 168
California, 93
Checkerboarding, 52
Cherokees, 60
Chickasaws, 60
Child labor decision, 195
Choctaws, 60
Clark, E. W., 1, 150
Cloud, Wilbur F., 83
Clute, Walter S., 85
Collins, Ray M., 155, 160, 163
Commission
  Corporation, 127, 158, 161, 162, 163
  Federal Trade, 23, 109, 111, 113, 130, 150
  Industrial, 125
  Interstate Commerce, 193
  Railroad, Texas, 158
Committee of Eleven, 106, 145, 149
Committee of Nine, 150, 199
Common law, 41, 44
Community
  Plan, 59
  lease, see lease
Competition, 124
Conditions, early economic, 15
Conference of governors, 153
Conservation, 37
  Defined, 5, 6
  Efforts, 81
  Federal legislation, 147
  Importance of, 154
  Laws, 201
  Obstacles to, 212
  Oklahoma, 127
  Oklahoma law, 206
  President Hoover's policy, 67
  Price, 123
Consumption, 152
  Gasoline, 214
  Statistics of, 222
Continental Oil Company, 68, 176
Control
  Government, 43, 129, 134, 135, 197, 200
  Involuntary, 216
  Unit, 88
  Voluntary, 216
Coolidge, President Calvin, 2, 4, 149, 192, 199, 211
Co-operation, 124, 132

Cosmic theory, 37
Cracking, 37, also see refinery
Creeks, 60
Crile, Austin D., 167
Crow Reservation, 61, 162
Cushing pool, 127
Cutler, W. W., Jr., 85
Cutting, Senator Bronson M., 153
Day, David T., 106
Decisions, early, 44
De Golyer, Everett, 148
Delaware Extension pool, 180
Demand, see supply
Derby Oil Company, 167
Derrick, Oil City, 56
Doheny, Edward L., 65
Doherty, Henry L., 132, 133, 137-144, 146-150, 152, 172, 188, 200
Doherty plan, 136ff
  Criticisms of, 148
  Disapproval of, 143-144
  Legal criticisms, 147
Drake, Col. E. L., 11
Drill, core, 74
Drilling,
  Close order, 84
  Cost of, 86
  Government control of, 197
  Regulation of, 153
  Technique of, 80
Dry holes, 77, 78, 79
Dry hole money, 79
Dunn, L. L., 149
Elizabeth Watts, 28
Empire Gas and Fuel Company, 18
Estabrook, E. L., 176
Farish, W. S., 150, 151, 172
Farmers' Co-operative scheme, 54
Federal Oil Conservation Board, see Board
Federal Trade Commission, see Commission
Fee, ownership of, 52
Fee owners' right, 45
Finney, E. C., 150
Fishing jobs, cost of, 77
Five Civilized Tribes, 60, 62
Fohs, Julius, 148
Free oil, 98
Frost-Johnson Lumber Company vs. Salling's Heirs, 49
Fuel Administration, United States, 20, 128, 140
Fuel Oil, 118, 138
Gasoline age, 25
Gas-oil ratios, 83
Gasoline consumption, see Consumption
Gilbert, Chester C., 128
General leasing act, 175
Geological Survey,
  Oklahoma, 73
  United States, 2, 73, 80, 106
Geologists, 37
Geology, 45
  Early theories, 56, 71
  Fields located according to, 40
  Influence of, 39
  Service of, 72
  Surface, 72
Geophysical instruments, 75
Geophysical methods, 74
George, H. C., 83
Glaeser, Martin G., 192
Government control, see Control
Government regulation, see Regulation
Grades, disadvantage of wide range, 97
Gravity, basis of price, 35
Gray, W. H., 116, 144
Grimm, H. P., 155
Gross production tax, 93, 215
Gulf Oil Corporation, 18
Haase, A. L., 194, 201
Hail vs. Reed, 44
Hammer vs. Dagenhart, 195
Haseman, W. P., 80, 85, 86
Hawley, Robt. D., 68
Hendricks field, 165
Hepburn act, 22, 23
Hepburn committee, 13
Herndon, C. C., 163
Hill, Harry H., 176
Hobbs field, 167
Holmes, Mr. Justice Oliver Wendell, 196
Hoover, President Herbert, 66, 67, 174
Hughes, Mr. Justice Charles Evans, 150, 200, 205
Humble Oil and Refining Company, 105, 178
Humble Pipeline Company, 167
Hydrogenation, 120
Hydro Patents Company, 121
Imports, 132
Independents, definition of, 17
Independent Petroleum Association, see Association
Indians, 62
Indian lands, 60, 61, 62
Industrial commission, see Commission
Industry, see Petroleum Industry
Inorganic theory, 37
Institute, American Petroleum, 80, 128, 131 134-139, 141-144, 149, 150, 154, 197, 200
Interior, Secretary of the, 61, 69
Interstate Commerce, 195, 196
Investigations, federal, 135ff
Involuntary control, see Control
Irwin, R. R., 97
Ise, John, 4
James, Wade H., 194, 201
Jensen, Joseph, 176, 177
Journal, The Oil and Gas, 23, 56, 76, 105, 107, 118, 121, 125, 139, 163, 167, 176, 182
Justice, department of, 193

Kansas vs. Colorado, 196
Kerosene age, 25
Kettleman Hills, 107, 175, 213
King, J. Berry, 161
La Follette, Robt. M., 136, 137
Lahee, Frederic H., 176, 178
Laissez faire, 71, 191
Lamber vs. Gant, 48
Lamp, The, 103, 116
Lane, Franklin K., 129
Laws, uniform, 83
Lease,
  Act, 175
  Classes, 57
  Community, 173, 174
  Departmental, 96
  First oil, 55
  Mid-Continent *88,* 57, 93
  "or" and "unless," 58
  Producers *88,* 57
  Provisions, 55
Lenapah pool, 180
Lewis, J. O., 80, 129, 149, 179, 180
Lima field, 122
Long Beach, 84, 88, 174
Losses, evaporation, 103
Lowrie, H. W., Jr., 155
Lyman, E. B., 120
Lyon gas conservation law, 82, 168, 206
McClintock, 55
McWilliams, J. R., 103
Magnetometer, 75
Malloy, Pat, 154
Manning, Van H., 129
Marco Polo, 9
Marietta process, 178
Marine shipping, 30
Market,
  Agreements, 95
  Early, 10
  Organized, 108
  Problem of, 94
  Unit of, 94
  Unorganized, 108
Marland, E. W., 144, 146, 154
Mendenhall, W. C., 37
Mid-Continent Oil and Gas Association, see Association
Midwest Refining Company, 175, 176
Mineral rights, see Oil and Gas Rights
Mitchell, William D., 152, 197
Monopoly, 21
Moore, Edward T., 166
Mountain Producers Corporation, 175
Myers, Abram F., 150
National City Bank Letter, 103
National Petroleum Marketers' Association, see Association
National Petroleum News, 166, 169
Natural gas,
  Effect of escape on oil, 83
  Legislation, 82
  Waste of, 83
Natural gasoline, 117
Naval oil reserves, 64
New York Times, 82
Nicholas, L. V., 98
Nicholas Oil Company, 21
Non-ownership theory, 45, 48, 49, 50
North Dome Committee, 175
O'Donnell, Thomas A., 131, 134, 135, 144, 150
Ohio Oil Company, 176
Ohio Oil Company vs. Indiana, 49, 202
Oil, see Petroleum
Oil and Gas Rights, 41ff
  Colonial times, 42
  Criticism of, 43
  Defense of, 43
  Distinct property, 47
  Influence of geology on, 45
  Latin America, 42
  Legal Interpretation, 44
  Manner of securing, 51, 52
  Transference of, 52
Oil exchanges, 99ff, 112
Oil fields, 34
Oil grades, 97
Oil Industry's Answer, 136
Oil Producer, 194
Oklahoma,
  Early fields, 73
  Payne County, 74
  Producers, 93
  School lands, 63
Oklahoma City field, 84, 91, 107, 213
Oliver, Earl, 176
Oliver Mining Company vs. Lord, 196
Operators, independent, 93
Organic theory, 38
Osages, 60, 62
Overproduction, 42
  Economic effect, 210
  Evils of, 128
  Limiting factor, 217
  Meaning of, 99ff
  Seasons of, 95
Oversupply, 132
Ownership,
  Right of, 46
  Theory, 45, 49, 50
Pan-American Petroleum and Transport Company, 18
Pecos County, 213
Pennsylvania Rock Oil Company, 56
Petroleum,
  Analysis of representative oils, 36
  Artificial recovery, 84
  Base, 33
  Chemical nature, 33
  Color of, 33
  Competition for markets, 93
  Demand and supply, 93
  Effect of surplus, 102

Fields, 34
Gasoline content, 100
Influence of gas on production, 81
Left underground, 80
Methods of classification, 33
Mexican, 35
Monthly index, 227
Nature and origin, 33, 37
Price, 93
Problem of extracting, 80
Production of, 26, 71
Production methods, 81
Purchasers, 110
Stocks, 222
Storage of, 101ff
South American, 35
Ultimate recovery, 83
Uses, 9, 31, 213
Use as fuel, 118ff
Utilization of, 141, 142
Value at wells, 221
Petroleum industry, 9ff
Attitude toward government, 191
Change in, 20
Competitive struggle, 193
Criticisms, 3
Divisions of, 22
Fear of, 192
Gasoline basis, 117
Groups accentuated, 154
Hazards of, 31
Importance of, 23
Increasing costs, 115
Influence of automobiles on, 43
Interdependence of, 23
Investment in, 23
Modern, 11
Most American, 26
Railroads and the, 24
Similar to railroads, 193
Supply uncertain, 27
Transportation in, 27
Unusual character, 26
Who is the, 24
Petroleum companies,
Investment of twenty, 18
Petroleum Producers' Association, see Association
Pew, J. Edgar, 150
Phillips, Isaac N., 57
Phillips Petroleum Company, 18
Pipelines, 22, 27
As purchasers, 95
Gathering lines, 94
Regulation of, 22
Pogue, *Economics of Petroleum,* 16, 133
Pogue, Joseph E., 128, 155
Police power, 204, 205
Posted price, 112, also see Price
Prairie Oil and Gas Company, 19, 23, 95, 97, 105, 113, 132
Prairie Pipeline Company, 19, 23
Pratt, Wallace E., 39
Preston vs. White, 47
Price,
Arbitrarily fixed, 109, 113
Based on gravity, 35, 96ff
Coal basis, 117, 118
Crude oil and gasoline, 103, 104
Early, 10
Effect on drilling, 114
Gasoline basis, 117
Influence of drilling costs, 115
Influence of low prices, 116
Influence of supply and demand, 114
Monopoly, 124
Posted price defined, 111
Problem of crude, 108ff
Refined and crude, 133
Statistics used as basis, 111
Variation between areas, 121
Wholesale index, 227
Prices, Profits and Competition, 193
Producers Associated Oil Company, 126
Producers' Protective Union, 126, 127
Producers in United States, 99
Production,
Agreement to shut down, 134
Excess, 152
Future of, 131, 132
Government control, 200
Individualistic, 210
Influence of new methods of, 210
Labor, 127
Large companies, 93
Meaning of, 7
Pool as unit of, 58
Regulation of, 42, 194
Report on world, 152
Restriction of, 125, 126, 127
Secondary recovery, 178
Statistics, 221, 222
Variation in costs, 116
Profits, 128
Progress, economic, 9
Property,
Concept of, 50
Rights, 41
Prorating, 132
Proration, 157ff
California, 168, 169
Effect on Oklahoma, 169
Hewitt field, 158
Kansas, 166
Law tested, 163, 164
Meanings of, 157
New Mexico, 167
Pecos field, 165
Seminole field, 159, 160
Texas, 164ff
Yates field, 164
Public land,
Acts relating to, 64ff
Conservation on, 69

Leases on, 63
Reversal of policy regarding, 68
Public utility, 22, 192
Purchases, 95
Pure Oil Company, 74, 178
Pure Oil Company vs. Kendall, 47
Rainbow Bend pool, 176
Ranney process, 178
Reeser, E. B., 107
Refined oils, 34
Refinery
Capacity in United States, 99, 105
Complete, 97
Cracking, 37, 117, 118, 120
Decreasing costs, 105
Reduction of operations, 105
Skimming plant, 97
Storage at, 102
Technology, 37
Regulation, 191ff
Reinhardt, William, 175
Reserves, depletion of, 131
Requa, M. L., 6, 128, 132, 153
Roberts, Dwight C., 88
Rockefeller Foundation, 25
Rockefeller, John D., 12, 15, 25, 110
Rockefeller, John D., jr., 25, 110
Rohlfs, J. C., 29
Royalty, 52
Business, 53
Owners, 96
Payment of, 53
Salt Creek field, 174
Salt domes, 75
Sand, porosity of, 81
Schriever, William, 83
Scouts, 95
Seismograph, 75
Seminole,
Curtailment plan, 159
Field, 107, 114
Greater, 76
Seminoles, 60
Shell Petroleum Company, 178
Shell Pipeline Company, 167
Shell Union Oil Corporation, 18
Shoshone Reservation, 61, 62
Sinclair Consolidated Oil Corporation, 18, 157
Sinclair, Harry F., 65, 134
Slichter, C. S., 81, 85
Smith-Dunn process, 178
Smith, George Otis, 75, 83, 129, 131, 153
Smith, Harry H., 156, 191
Stabilization, 24
Contributing factor to, 91
Effect of flush production on, 71
Effect of technology on, 71
Efforts, 125
Problem, 209ff
Handicap to, 58, 125, 212
Meaning of, 7
Modern movement for, 128ff
Output, 216
Price, 123, 216
Suggestions for, 133, 213
Two-fold problem, 1
Standard-I. G. Company, 121
Standard Oil Company, 126, 127, 191, 209
Decentralization of, 25
Dissolution of, 16
Influence of, 13
Origin of, 12
Original trust agreement, 15
Reasons for success of, 13
Ownership of, 20, 25
Standard Oil Company, California, 19, 25
Standard Oil Company, Indiana, 19, 25
Standard Oil Company, New Jersey, 16, 21, 30, 105, 121
Standard Oil Company, New York, 19, 21
Standard Statistics Company, 91
Stephens County vs. Mid-Kansas Oil and Gas Company, 47
Storage,
Cost of, 102
Doherty suggestions, 139
Purpose of, 103
Summers, Walter L., 49
Sun Oil Company, 178
Supply,
Control of, 194
Estimates of future, 106
Exhaustion of, 134
Supply and Demand, 100, 123, 128, 139
Supreme Court, United States, 23, 48, 191, 203, 205
Sweeney, Stender, 88
Taft, William Howard, 64
Tanks, 102
Tankships, 28ff
Tariff, 30
Tax, gross production, 93, 215
Tea Pot Dome, 65
Teagle, Walter C., 111, 119, 150, 159, 172
Temperature, effect on oil, 94
Tenth amendment, 197
Texas,
Early fields, 73
Public lands, 63
Texas Company, 18, 23, 25, 178
Texas Company vs. Daugherty, 47
Texas Pipeline Company, 23
Thomas, J. Elmer, 155
Thorpe, Merle, 207
Tide Water-Associated Oil Company, 18
Tolman, C. F., 38
Torrey, Paul D., 107
Torsion balance, 75
Trammel, Senator, 109
Transportation,
Early, 12
Marine, 28
Pipelines, 27

Water, 28
Twin State Oil Company, 74
Union Oil Company, California, 18, 59
Unit Control, 88
United Mine Workers vs. Coronado Coal Company, 196
United States Fuel Administration, see Fuel Administration
Unitization
Defined, 172
Handbook, 156
Unit operation, 172ff
Adjustment form contract, 186
Advantages of, 149, 189
A. I. M. E. study, 176
Beaty's plan, 172, 173
Community lease, 173
Co-operative development contract, 187
Disadvantages, 189
Economic effects, 134
Elk Basin field, 176
Government land, 174
Government recognition, 175
Involuntary co-operation, 199
Key well schedule, 188
Legal phases, 195
Never tested, 201
Not monopoly, 172
Opposition to, 194
Plans, 172ff
Plan illustrated, 183
Recommended contracts, 182
Rules of practice, Mid-Continent Oil and Gas Association, 181
Secondary Recovery, 179
Simple method outlined, 172
Survey of, 180
Trustee form contract, 185
Van Zandt county, 178
Uren, Lester C., 85
Use, unessential, 123
Value,
Economic, 4, 216
Meaning of, 2
Scarcity, 5, 216
Theory of, 123ff
Use, 4, 216
Values, essential, 2, 4
Vanderbilt, William H., 13
Van Zandt pool, 178
Vaught, Judge Edgar S., 163
Veasey, James A., 150, 154, 191, 204, 205
Vedder, Richard O., 70
Voluntary control, see Control
Walsh, Senator, 175
Waste,
Definition, 1, 5
Due to haste, 140
Example of, 51
Factors of, 1
Law prohibiting, 158
Oklahoma law, 1
Opinion of leaders, 146
Texas law, 2
Water drive, 178
Watts, W. W., 127
Weekly, The *Oil,* 149
Wellington Dome, 59
Wells,
Acreage spacing, 84, 85, 86
Completed, statistics, 221
Cost of drilling, 89
Deepest nonproducing, 35
Deepest producing, 35
Drilled, 77, 91, 225
First, 11
First in Oklahoma, 73
Initial production, 90
Necessity of pumping, 116
Restraint on, 47
Right to drill, 46
Second, 11
Western Petroleum Refiners Association, see Association
Westmoreland and Cambria Natural Gas Company vs. Dewitt, 45
White, David, 106
White Eagle Oil and Refining Company, 21, 97
Wilbur, Ray Lyman, 69, 70, 105, 152, 175, 197
Wildcatter, influence of, 77
Wildcatting, risk of, 79
Wilson, Woodrow, 65
Wind River Reservation, 61
Wood, Fred E., 176, 177
Woody pool, 180
Work, Hubert, 6, 151, 172
Yates pool, 107, 116

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